RECORD OF DECISION

Operable Unit One
New Cassel/Hicksville Ground Water Contamination Superfund Site
Towns of North Hempstead, Hempstead and Oyster Bay,
Nassau County New York

United States Environmental Protection Agency
Region II
New York, New York
September 2013

DECLARATION FOR THE RECORD OF DECISION

SITE NAME AND LOCATION

New Cassel/Hicksville Ground Water Contamination Superfund Site
Towns of North Hempstead, Hempstead, and Oyster Bay, Nassau County, New York

Superfund Site Identification Number: NY0001095363
Operable Unit 01

STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD) documents the U.S. Environmental Protection Agency's (EPA's) selection of an interim remedy for OU1 of the New Cassel/Hicksville Ground Water Contamination Superfund site (Site), in the Towns of North Hempstead, Hempstead, and Oyster Bay, New York, which is being chosen in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended, 42 U.S.C. §§ 9601-9675, and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 C.F.R. Part 300. This decision document explains the factual and legal basis for selecting the OU1 remedy. The attached index (see Appendix III) identifies the items that comprise the Administrative Record upon which the selected remedy is based.

The New York State Department of Environmental Conservation (NYSDEC) was consulted on the proposed remedy in accordance with CERCLA Section 121(f), 42 U.S.C. § 9621(f), and concurs with the selected remedy (see Appendix IV).

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from the Site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

The response action in this ROD represents the first remedial phase, or first operable unit (OU), for the Site. It actively addresses groundwater contamination in the area downgradient of Old Country Road, Grand Boulevard, and the New Cassel Industrial Area (NCIA) and is considered an interim remedy which is intended to address only this portion of the Site. The EPA anticipates conducting a separate investigation of one or more additional OUs to address groundwater contamination at the Site, including in the far-afield area further downgradient of the portion of the plume addressed in this OU1. Additional planned OUs for the Site include, but may not be limited to, areas of groundwater contamination impacting the Hicksville public supply wells 5-2, 5-3, 4-2, 8-1, 8-3, 9-3 and Hempstead-Levittown 2A.

The major components of the selected remedy include the following:

- A combination of (a) in-situ treatment of groundwater via in-well vapor stripping and (b) extraction of groundwater via pumping and ex-situ treatment of extracted groundwater prior to discharge to a publicly owned treatment works or reinjection to groundwater (to be determined during design). The purpose is to establish containment and effectuate removal of contaminant mass where concentrations of total volatile organic compound concentrations are greater than 100 micrograms per liter;

- In-situ chemical treatment, such as in-situ chemical oxidation, to target high concentration contaminant areas, as appropriate;

- Implementation of long-term monitoring to track and monitor changes in groundwater contamination in OU1 to ensure the remedial action objectives are attained;

- Development of a Site Management Plan to ensure proper management of the remedy post-construction. The Site Management Plan will include provisions for any operation and maintenance and long-term monitoring required for the remedy, as well as periodic certifications; and

- Institutional controls consisting of any existing local requirements that prevent installation of drinking water wells, and informational devices to limit exposure to contaminated groundwater.

Individual facilities within the NCIA are considered to be among the sources of groundwater contamination for OU1. Response actions which are addressing sources of contamination in the NCIA are being conducted at those upgradient facilities, and they continue to be overseen by NYSDEC under its state hazardous waste cleanup program. The on-going, State-authorized response actions at the NCIA facilities are not part of this OU1, although the successful completion (i.e., source control or cleanup) of addressing the source area(s) at the upgradient individual NCIA facilities, under NYSDEC oversight are anticipated and was assumed in evaluating the potential for attaining the objectives of the selected remedial alternative in this ROD. In the event that theses sources are not successfully addressed, the EPA may elect to evaluate additional options at individual NCIA facilities pursuant to CERCLA in a future operable unit to ensure the effectiveness of the selected remedy.

The environmental benefits of this remedy may be enhanced by giving consideration, during the design phase, to technologies and practices that are sustainable in accordance with the EPA Region 2's Clean and Green Energy Policy[1]. This will include consideration of green remediation technologies and practices, including granular activated carbon regeneration.

DECLARATION OF STATUTORY DETERMINATIONS

The selected remedy meets the requirements for remedial actions set forth in CERCLA Section 121, 42 U.S.C. § 9621, in that it: 1) is protective of human health and the environment; 2) meets a

[1] See http://epa.gov/region2/superfund/green_remediation.

level or standard of control of the hazardous substances, pollutants, and contaminants which at least attains the legally applicable or relevant and appropriate requirements under federal and state laws (unless a statutory waiver is justified); 3) is cost-effective; and 4) utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous substances as a principal element (or justify not satisfying the preference).

This remedy will result in hazardous substances, pollutants, or contaminants remaining at this OU until performance standards are attained, and as such, use and exposure must be limited until such standards are met. Since it may take more than five years to attain the cleanup levels, policy reviews pursuant to Section 121(c) of CERCLA will be conducted no less often than once every five years after the completion of construction to ensure that remedy is, or will be, protective of human health and environment.

DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section of this ROD. Additional information can be found in the Administrative Record for this Site.

- ✓ A discussion of the current nature and extent of groundwater contamination is included in Section 5.8;
- ✓ Chemicals of concern and their respective concentrations may be found in Section 7 "Summary of Site Risks" and Table 7 in Appendix II;
- ✓ Potential adverse effects associated with exposure to Site contaminants may be found in Section 7 "Summary of Site Risks;"
- ✓ A discussion of cleanup levels for chemicals of concern may be found in Section 8 "Remedial Action Objectives" and in Table 7 in Appendix II;
- ✓ A discussion of principal threat waste is contained in Section 11 "Principal Threat Wastes;"
- ✓ Current and reasonably-anticipated future land use assumptions are discussed in Section 6 "Current and Potential Future Land and Resources Uses;"
- ✓ Estimated capital, annual operation and maintenance, and total present worth costs are discussed in Section 9 "Descriptions of Alternatives;" and
- ✓ Key Factors in detailed analyses of viable remedial alternatives (*e.g.*., how the selected remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria) may be found in Section 10 "Comparative Analysis of Alternatives" and Section 13 "Statutory Determinations."

AUTHORIZING SIGNATURE

Walter E. Mugdan, Director   Date

Emergency and Remedial Response Division

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DECISION SUMMARY

1. SITE NAME, LOCATION, AND DESCRIPTION

The New Cassel/Hicksville Ground Water Contamination Superfund site (Site) comprises a widespread area of groundwater contamination within the Towns of North Hempstead, Hempstead, and Oyster Bay, Nassau County, New York. The Site is estimated to include approximately 6.5 square miles that has been characterized by volatile organic compound (VOC) contaminated groundwater that has impacted several public supply wells, including four Town of Hempstead wells (Bowling Green I and II, Roosevelt Field 10, and Levittown 2A), six Hicksville wells (4-2, 5-2, 5-3, 8-1, 8-3, and 9-3), and one Village of Westbury well (11). Analytical results of groundwater samples from the Site have revealed concentrations of VOCs in excess of the EPA's promulgated health-based protective maximum contaminant levels (MCLs), which are enforceable standards for various drinking water contaminants and New York State's standards

This Record of Decision (ROD) addresses a discrete portion of contaminated groundwater downgradient of the New Cassel Industrial Area (NCIA), which is managed and referred to as Operable Unit 1 (OU1) of the Site. The Site's OU1 is located within the Towns of North Hempstead and Hempstead. OU1 is located primarily in Salisbury, an unincorporated area of the Town of Hempstead; however the portion of OU1 north of Grand Boulevard is located within the Hamlet of New Cassel in the Town of North Hempstead. A Site location map, which highlights the area encompassing OU1, is provided as Figure 1 in Appendix I.

The area comprising OU1 includes approximately 211 acres and consists of residential properties, as well as some commercial areas. Upgradient of OU1, the NCIA encompasses approximately 170 acres of land. The NCIA is bounded by the Long Island Railroad to the north, Frost Street to the east, Old Country Road to the south and Grand Boulevard to the southwest.

The Town of Hempstead's Bowling Green Water District operates Wells 1 and 2 on property located within OU1. The Bowling Green Water District has been treating groundwater pumped from these two wells since 1990, when a granular activated carbon (GAC) system was installed. Five years later the treatment system was supplemented with an air stripper, and the treatment systems continue to be in operation. The Town of Hempstead continues to maintain monitoring and treatment activities to address VOC contamination prior to its distribution to the drinking water system.

2. SITE HISTORY AND ENFORCEMENT ACTIVITIES

In 1986, as part of a county-wide groundwater investigation, Nassau County Department of Health identified extensive groundwater contamination throughout the NCIA. Groundwater data revealed that contaminants from the NCIA impacted the Bowling Green Water District water supply, which is comprised of two public supply (extraction) wells and is approximately 1,000 feet downgradient of the NCIA[2]. The NCIA was developed for industrial use during the 1950s through the 1970s and remains densely populated with an estimated 200 industrial and commercial properties. Review of Nassau County Department of Health and New York State

[2] Both of the Bowling Green water supply wells were constructed in 1975 and have a permitted pumping capacity of 1,400 gallons per minute.

Department of Environmental Conservation (NYSDEC) reports indicates that leach pools and/or dry wells located on upgradient properties in the NCIA were generally used for disposal of wastewater at these facilities until sewers were installed.

Following the Nassau County Department of Health investigation and the Town of Hempstead's steps to protect its water supply system, NYSDEC conducted site assessment activities within the NCIA from 1994 to 1999 to identify the sources of the groundwater contamination. Based on NYSDEC's findings, 17 individual facilities within the NCIA were listed on NYSDEC's Registry of Inactive Hazardous Waste Disposal Sites between May 1995 and September 1999. Investigations have been completed, and response actions have been selected by NYSDEC under state law for the 17 facilities. Of the 17 facilities, five require no further action, one requires further monitoring, and 11 have on-going response actions including continued operation of air sparging and soil vapor extraction systems.

NYSDEC determined that a variety of disposal activities within the NCIA had resulted in the disposal of hazardous wastes, including 1,1,1-trichloroethane (TCA), tetrachloroethene (PCE), and trichloroethene (TCE), which are chlorinated VOCs. Some of these hazardous wastes were released or have migrated from the NCIA to surrounding areas, including the area bordering the NCIA south of Old Country Road and Grand Boulevard. Individual facility descriptions, operational/disposal histories, and cleanup histories for facilities within the NCIA can be found in NYSDEC's 2003 ROD entitled, "New Cassel Industrial Area Sites, Town of North Hempstead, Nassau County, New York, Off-site Groundwater South of the New Cassel Industrial Area Operable Unit No. 3" (to avoid confusion, note that "OU3" in this instance is the geographical designation that NYSDEC assigned to a portion of the area that the EPA has designated as OU1.)

In October 2003, NYSDEC selected a remedy under its State authorities to address groundwater contamination downgradient of the NCIA. NYSDEC's remedy called for remediation of the upper and deep portion of the aquifer (to a depth of 225 feet below ground surface (bgs)) with in-well vapor stripping/localized vapor treatment. NYSDEC's remedy included a contingency plan to utilize ex-situ extraction and treatment (more commonly known as groundwater pump and treat) if pilot-testing caused NYSDEC to determine that the State's remedy was less practical because of engineering or economic reasons.

The State has not implemented the 2003 remedy it selected under its state authorities. Rather, it carried out pre-design activities and then requested that the EPA include the Site on the National Priorities List (NPL). In 2009, NYSDEC retained consultants to perform pre-design investigations, and based on that first investigation, NYSDEC determined that the Magothy aquifer is anisotropic,[3] and as a result, concluded that in-well vapor stripping may not be an effective technology for remediating all of the groundwater. Thereafter, NYSDEC decided that the contingency remedy of ex-situ extraction and treatment of the contaminated groundwater was more appropriate, and a subsequent pre-design investigation for the contingency remedy was completed in December 2011. However, as mentioned above, this remedy has not been implemented. No further actions were taken by NYSDEC related to what they referred to as the off-site groundwater south of the NCIA. On September 16, 2011, the EPA listed the Site on the NPL.

[3] In an anisotropic aquifer, the hydraulic conductivity (measurement of ease in which water can flow through the aquifer material) is different in the horizontal and vertical direction.

3. COMMUNITY PARTICIPATION

On July 26, 2013, the EPA released the Proposed Plan for cleanup of OU1 of the Site to the public for comment. The EPA assembled supporting documentation, which comprises the administrative record, and has made it available to the public at the information repositories maintained at the Westbury Public Library in Westbury, New York, and the EPA Region 2 Office in New York City.

Notice of the July 26, 2013 start of the public comment period and the availability of the above-referenced documents was published in *The Westbury Times* on July 31, 2013. The public comment period, originally scheduled to be 30 days, was extended to September 24, 2013, after EPA received a request for an extension of time. Notice of an extension to the public comment period to September 24, 2013 was published in *The Westbury Times* on August 23, 2013. Copies of both public notices published in *The Westbury Times* can be found in Appendix V.

On August 15, 2012, the EPA held a public meeting at the "Yes We Can" Community Center in North Hempstead to inform local officials and interested citizens about the Superfund process, to present the Proposed Plan for OU1 of the Site, including the preferred proposed remedial alternatives, and to respond to questions and comments from the attendees. Responses to the questions and comments received at the public meeting and in writing during the public comment period are included in the Responsiveness Summary (See Appendix V).

4. SCOPE AND ROLE OF RESPONSE ACTION AT OPERABLE UNIT ONE

Section 300.5 of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 C.F.R. Section 300.5, defines an OU as a discrete action that comprises an incremental step toward comprehensively addressing a site's problems. A discrete portion of a remedial response eliminates or mitigates a release, a threat of release, or pathway of exposure. Cleanup of a site can be divided into number of OUs, depending on the complexity of the problems associated with the site.

Cleanup of this Site will be addressed in discrete phases or components, and it is anticipated that there will be multiple OUs for the Site, and subsequent Proposed Plans and RODs will address groundwater contamination related to other OUs at the Site.

The primary objectives of the actions set forth in this ROD are to address the OU1 groundwater contamination, reduce the migration of contaminants, and minimize any potential future negative health impacts. This ROD addresses groundwater contamination in the area downgradient of the NCIA and is designated as OU1 for the Site. A map of OU1 is provided as Figure 1, which can be found in Appendix I.

The EPA anticipates conducting a separate investigation of a second OU to address groundwater contamination in the far-afield area further downgradient of the portion of the plume addressed in this OU1. This would lead to a remedy selection process which may result in the selection of another remedy that would be consistent with the actions selected in this ROD. The remedy selected for OU1 is intended to, among other things, minimize further migration of contaminants while an investigation of the far-afield area is being conducted (among other areas). Additional OUs for the Site would include, but may not be limited to, areas of groundwater contamination impacting the Hicksville public supply wells 5-2, 5-3, 4-2, 8-1, 8-3, 9-3 and Hempstead-Levittown 2A. It is anticipated that these other OUs will likewise proceed through the remedy selection process. Furthermore, a subsequent remedy for groundwater at the entire Site, including OU1, will be addressed in a future Proposed Plan and ROD.

Individual facilities within the NCIA are considered to be among the sources of groundwater contamination for OU1. Response actions which are addressing sources of contamination in the NCIA are being conducted at those upgradient facilities, and they continue to be overseen by NYSDEC under its state hazardous waste cleanup program. The on-going, State-authorized response actions at the NCIA facilities are not part of this OU1, although the successful completion (*i.e.*, source control or cleanup) of addressing the source area(s) at the upgradient individual NCIA facilities, under NYSDEC oversight are anticipated and was assumed in evaluating the potential for attaining the objectives of the selected remedial alternative in this ROD.

The effectiveness of the remedy selected in this ROD presumes that the actions currently being overseen by NYSDEC under agreements it has with individual NCIA facility owners/operators will prove to be effective in addressing contaminant sources at those facilities within the NCIA. In the event that contaminant source control is not successfully achieved pursuant to NYSDEC's on-going cleanup efforts, the EPA may elect to evaluate additional options at individual NCIA facilities in separate, subsequent OUs in the future pursuant to the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended, 42 U.S.C. §§ 9601-9675, to ensure the effectiveness of the remedy selected by the EPA for this OU1.

5. SUMMARY OF OPERABLE UNIT ONE CHARACTERISTICS

5.1 Overview

In 2011, after the Site was included on the NPL, the EPA commenced its Supplemental Remedial Investigation which resulted in the Supplemental Remedial Investigation Memorandum, dated July 2013. The Supplemental Remedial Investigation Memorandum summarizes historical groundwater data, outlines response activities conducted, characterizes the Site, and provides recommendations for future investigation and response activities at the Site. The evaluation of groundwater contamination downgradient of the NCIA, designated as OU1 by the EPA, included a review of NYSDEC's September 2000 study, October 2003 remedy, and the 2009 and 2011 Pre-Design Investigation Reports.

Section 5 of the Supplemental Remedial Investigation Memorandum includes summaries of these aforementioned investigations conducted under state law with NYSDEC oversight prior to the Site listing on the NPL. The document also provides a summary of Site Characteristics for OU1 from the EPA's Supplemental Remedial Investigation.

5.2 Site Geology/Hydrogeology

The principal hydrogeologic units underlying OU1 at the Site are the glacial outwash and morainal deposits known as the Upper Glacial Aquifer (UGA) and the underlying Magothy Formation and Matawan Group (Magothy). Beneath these two units are the clay member and the Lloyd Sand member of the Raritan Formation.

The UGA is estimated to be 40 to 65 feet thick and consists predominantly of coarse-grained sands and gravels. A distinct contact between the UGA and the Magothy units has not been observed in the area. The underlying Magothy formation sediments (estimated to be approximately 600 feet thick) are characterized by sand and silty sand with discontinuous clay and silt layers. Geologic studies in the area have revealed that sediments tend to become finer in size fraction downward in the Magothy formation, except within the basal portion where coarse-grained sands and gravels are prevalent.

Unconfined groundwater is generally found at the Site between 40 and 65 feet bgs, which is near the estimated boundary between the UGA and Magothy aquifers. Groundwater within the UGA and Magothy aquifers flows in a south-southwest direction in the area downgradient of the NCIA. Pumping of the Bowling Green water supply wells is likely to influence the groundwater flow direction above the depth of their production interval of approximately 470 to 580 feet bgs.

5.3 Summary of NYSDEC's 2000 Remedial Investigation Study

By 2000, NYSDEC had performed its remedial investigation activities that included the collection of three rounds of groundwater samples from a network of 50 solitary and clustered groundwater monitoring wells[4] in the vicinity of the NCIA. Groundwater monitoring wells were installed at various depths that targeted four depth ranges (*i.e.*, 0 to 64 feet, 65 to 99 feet, 100 to 124 feet and 125 to 200 feet bgs). Early warning monitoring well clusters located upgradient of the Bowling Green water supply wells, were also sampled at depths ranging from 132 to 164 and 504 to 516 feet bgs. These early-warning monitoring wells were installed to monitor contamination in the groundwater upgradient of the two Bowling Green water supply wells. The early-warning monitoring wells became part of a network of monitoring wells that were sampled in support of NYSDEC's investigation of the groundwater contamination downgradient of the NCIA.

Groundwater samples were analyzed for VOCs. During the third round of sampling, samples from a subset of the groundwater monitoring wells were also analyzed for physical and chemical parameters to assist in a monitored natural attenuation evaluation. Additionally, 39 groundwater samples were collected from four Hydropunch® borings (GWHP-01 through GWHP-04) in 2000. The location of the monitoring wells and Hydropunch® borings can be found in NYSDEC's September 2000 Remedial Investigation Report for the "New Cassel Industrial Area Off-site Groundwater."

5.3.1 Summary of NYSDEC's Remedial Investigation Results

NYSDEC concluded in its 2000 Remedial Investigation Report for the "New Cassel Industrial Area Off-site Groundwater," that the primary contaminants were PCE, TCE, and TCA. Breakdown products of PCE, TCE, TCA and other minor constituents within the VOC category were also present. Three groundwater plumes were identified within the NYSDEC's study area

[4] The term "clustered groundwater monitoring wells" refers to monitoring well locations where there are two or more wells at different depth intervals.

downgradient of the NCIA, and they were identified as having emanated from the NCIA. NYSDEC attributed the source of groundwater contamination within its study area to the individual NYSDEC Registry facilities located upgradient and within the NCIA. Potential sources of groundwater contamination from sources upgradient of the NCIA were not identified. Groundwater samples collected from upgradient wells as part of the State's investigation contained levels of PCE from nondetect to 14 μg/L and no detectable levels of TCE.

The distribution of contamination within NYSDEC's study area was determined to be influenced by local geology and hydrogeology. This included the effect from the pumping of the Bowling Green water supply wells which produces a significant downward vertical gradient (*i.e.* drawing the groundwater deeper and toward it) in the vicinity of the NCIA. Additionally, NYSDEC determined that the presence of some breakdown products suggests that biodegradation of VOCs has occurred; however, the degree of biodegradation is limited within the area downgradient of the NCIA.

5.4 NYSDEC's 2003 Remedy Selection

In October 2003, NYSDEC selected a remedy under its State authorities to address what it termed the "Off-site Groundwater South of the New Cassel Industrial Area." NYSDEC's remedy called for remediation of the upper and deep portion of the aquifer (to a depth of 225 feet bgs) with in-well vapor-stripping/localized vapor treatment. NYSDEC's remedy included a contingency plan to utilize ex-situ extraction and treatment (more commonly known as groundwater pump and treat) if it were determined during pilot testing that the in-well approach is less practical because of engineering or economic reasons.

5.5 NYSDEC's 2006 to 2009 Vapor Intrusion Investigations

From 2006 to 2009, NYSDEC conducted vapor intrusion investigations downgradient of the NCIA. Investigations were conducted in three phases to assess whether VOCs from the NCIA are volatilizing and entering structures in areas in the vicinity of the NCIA.

Phase 1 was conducted in September 2006 and included the collection of soil vapor samples at 38 locations throughout NYSDEC's study area downgradient of the NCIA. At each of 38 locations, one sample was collected approximately six to ten feet above the water table (generally 29 to 45 feet bgs), and one sample was collected at approximately eight feet bgs (the typical depth of a building's foundation).

As a screening evaluation, NYSDEC compared results from the Phase 1 soil vapor sampling to the New York State Department of Health's (NYSDOH) *Guidance for Evaluating Soil Vapor Intrusion in the State of New York* dated September 2006, which includes guidelines for indoor air concentrations for PCE and TCE, which are 100 and 5 micrograms per cubic meter (μg/m^3), respectively. This comparison provided for the targeting of locations for subsequent phases of the vapor intrusion investigation. Phase 1 results identified PCE concentrations up to 1,086 μg/m^3. TCE was identified at concentrations up to 363 μg/m^3. Based on the results, NYSDEC determined that indoor air sampling should be conducted at W.T. Clarke High School as soil vapor samples within the vicinity identified TCE concentrations above NYSDOH air guidelines.

Phase 2 began in September 2007 and included the collection of six indoor air samples from the basement and first floor locations and one outdoor (ambient air) location at the W.T. Clarke High School. Phase 2 results were compared to NYSDOH air guidance values, and concentrations of the identified NYSDEC's contaminants of concern were below levels of concern. The ambient air sample, which serves as a measurement of background concentrations, had a concentration of TCE at 3.71 $\mu g/m^3$. The TCE ambient air result was higher than the indoor air concentrations and was, therefore, unlikely the result of volatilization of contaminants from contaminated groundwater. The maximum concentration of PCE 2.28 $\mu g/m^3$ from a first floor indoor air sample was below both NYSDOH and the EPA guidance values. Additionally, concentrations of carbon tetrachloride and benzene were identified up to 0.831 $\mu g/m^3$ and 1.95 $\mu g/m^3$, respectively. While NYSDOH did not have an indoor air guidance value for carbon tetrachloride and benzene, these values do not exceed the EPA's upper bound acceptable risk levels for those two substances.

Phase 3 was conducted in March 2009, and included collection of outdoor air, indoor air and/or subslab samples at the W.T. Clarke High School, seven residential properties, and a Town of Hempstead Water Department facility. Phase 3 results at the W.T. Clarke High School did not identify detections in indoor air or subslab samples above levels of concern. Both PCE and TCE were not detected in the indoor air above their reporting limits. TCA was detected in the indoor air up to 1.3 $\mu g/m^3$ and, while NYSDOH does not have an indoor air guidance value for this VOC[5], it does not exceed the EPA's current risk based screening level of 5,200 $\mu g/m^3$. Methylene chloride was detected at concentrations of up to 14 $\mu g/m^3$ in the indoor air, however, NYSDOH's air guidance value is 60 $\mu g/m^3$. Based on these results, NYSDEC determined that no further action was necessary, which was in accordance with NYSDOH's 2006 Guidance.

Results from Phase 3 sampling at the seven residential properties did not identify detections in the indoor air above levels of concern for NYSDEC's contaminants of concern. Subslab sampling at six residential properties indicated that the highest concentrations of PCE and TCE were 15 $\mu g/m^3$ and 14 $\mu g/m^3$, respectively. Based on comparison of these results to NYSDOH's 2006 Guidance, one residence, located approximately 500 feet downgradient from the NCIA was selected for future monitoring.

Phase 3 additionally included vapor intrusion sampling at a Town of Hempstead Water Department facility located at the Bowling Green water supply wells. Chloroform, a compound for which the NYSDOH does not have a respective air guidance value, was detected in the indoor air at concentrations of 150 $\mu g/m^3$ and in the subslab at concentrations of 81,000 $\mu g/m^3$. The EPA's current risk based industrial indoor air value for chloroform is 0.53 $\mu g/m^3$. Other NYSDEC contaminants of concern were not detected above levels of concern in the indoor air. No further actions were taken by NYSDEC subsequent to the completion of the three phases of the vapor intrusion investigations.

5.6 NYSDEC's 2009 Pre-Design Investigation

After selection of its remedy in 2003, NYSDEC conducted a pre-design investigation, which was completed in 2009. The 2009 pre-design investigation included a groundwater quality assessment

[5] NYSDOH's 2006 *Guidance for Evaluating Soil Vapor Intrusion in New York State* provides guidance on actions that should be taken to address current and potential exposures related to soil vapor intrusion and can be used to evaluate indoor air data for 1,1,1-TCA. Currently, there are no NYSDOH air guidance values for sub-slab data.

from existing monitoring wells, vertical profile groundwater sampling from temporary monitoring wells, geologic profiling, soil sampling, and gamma logging. Seven temporary monitoring wells were advanced to a depth of 285 feet bgs, which is comparable to the depth of the deepest permanent monitoring well locations. At two additional locations, temporary monitoring wells were installed in the western plume area and the central-eastern plume area to a depth of 502 feet bgs. Groundwater samples were collected at 20-foot intervals from the water table (approximately 45 feet bgs) down to 502 feet bgs. Results from these two temporary monitoring wells documented the presence of Site-related VOC contamination at depths up to 502 feet bgs.

5.6.1 Monitored Natural Attenuation Evaluation

The 2009 pre-design investigation evaluated available groundwater monitoring sampling results collected quarterly subsequent to the selection of the State's 2003 remedy, to determine whether the data corresponds with previous conclusions drawn in 2003. Review of the data indicated that the chlorinated VOCs comprise two general suites of parent and degradation or "daughter products," ethanes and ethenes. An evaluation of the occurrence and distribution of ethane compounds in the VOC plume suggested that degradation was occurring.

Historically, the parent compound TCA was the primary ethane species constituent detected in wells within the NCIA. However, in wells downgradient of the NCIA, the percentage of TCA decreased relative to the wells within the NCIA while the percentage of 1,1-dichloroethane (1,1-DCA) increased relative to the NCIA wells, indicating the degradation of TCA to 1,1-DCA.

However, evaluations were not able to determine whether breakdown of ethene constituents was occurring because of the varying occurrence and distribution of the ethene parent and breakdown compounds between the NCIA and downgradient wells. Historically, the distribution of ethene constituents in the wells located within the NCIA was comprised mainly of breakdown products 1,1-dichloroethene (1,1-DCE) and 1,2-dichloroethene (1,2-DCE), while wells downgradient of the NCIA contained relatively higher amounts of the parent products PCE and TCE. As part of the natural attenuation evaluation, some additional parameters that would be indicative of the biodegradation of chlorinated VOCs were collected from a limited set of monitoring wells. The data did not reveal the presence of ferrous iron, indicating that a reducing environment may not be present at those locations. Total organic carbon was also not detected. The presence of total organic carbon would have indicated a potential energy source for biodegradation. In addition, byproducts of biodegradation *(i.e.*, alkalinity, chlorides, carbon dioxide, and methane) were not detected at elevated concentrations. Parameters such as sulfide and hydrogen were not screened for during this evaluation.

Based on these factors, significant biodegradation of the VOC contaminant plumes does not appear to be occurring within OU1. However, the presence of some breakdown products suggests that a limited degree of biodegradation is occurring within OU1.

5.6.2 Evaluation of Hydrogeologic Conditions

Results from NYSDEC's 2009 pre-design investigation indicated that, based on literature data for the Magothy in the vicinity of the area proposed for treatment, anisotropy ratios (*i.e.*, ratio of vertical to horizontal hydraulic conductivity) of approximately 100 are not uncommon. Vertical hydraulic conductivity sampling measurements based on discrete soil sampling of the Magothy revealed higher degrees of anisotropy (*i.e.*, average was 42,700). NYSDEC concluded in its 2009 pre-design investigation that in-well vapor stripping would not be an effective technology for remediating groundwater and recommended use of the contingency remedy of groundwater extraction and treatment.

5.7 NYSDEC's 2011 Pre-Design Investigation

In 2011, NYSDEC conducted a second pre-design investigation that included the installation of 11 new monitoring wells and two extraction (pumping) wells, a 72-hour aquifer pump test of an extraction well, and a pilot test/treatability study for ex-situ treatment of contaminated groundwater.

Results from NYSDEC's 2011 pre-design investigation, which included sampling from the recently expanded monitoring well network, indicated that the impacted area of groundwater had a larger horizontal and vertical extent than previously determined in NYSDEC's 2000 study. The water level monitoring conducted as part of the 72-hour aquifer pump test revealed that the Bowling Green water supply wells strongly influence the water levels in all of monitoring wells located in the Magothy that were monitored during the test. Results from this pump test indicated test extraction wells were relatively high yielding, and NYSDEC determined that a series of high yielding pumping wells would be required to capture known contamination.

Data from the 72-hour aquifer pump test was additionally used to calculate aquifer characteristics, including anisotropic ratios, which were determined to be significantly lower (27 to 100) than the original estimate from the 2009 pre-design investigation. Calculated results for anisotropy were within the published ranges from several United States Geologic Survey studies on Long Island. Based on this information collected, these results are consistent with NYSDEC's initial conclusion in its 2003 state remedy.

NYSDEC concluded, based on its 2011 pre-design investigation that the contaminant plumes were stable with localized areas where declining or increasing concentration trends are observed. Concentrations of PCE/TCE breakdown compounds are relatively low to nondetect compared to the concentrations of PCE and TCE, which indicates that their biodegradation is not progressing at a significant rate within OU1. Concentrations of Site related VOCs in the early warning monitoring wells were below their respective federal MCLs and State water quality standards.

5.8 EPA's Supplemental Remedial Investigation Memorandum

In 2011, after the Site was added to the NPL, the EPA commenced its Supplemental Remedial Investigation which resulted in the Supplemental Remedial Investigation Memorandum, dated July 2013. The EPA's Supplemental Remedial Investigation Memorandum summarizes historical groundwater data, outlines response activities conducted, sets forth Site characteristics, and provides recommendations for future investigation and response activities at the Site. The evaluation of groundwater contamination downgradient of the NCIA, designated as OU1 by the EPA, included a review of the aforementioned NYSDEC's September 2000 study, October 2003 remedy, and the 2009 and 2011 Pre-Design Investigation Reports.

5.8.1 Summary of EPA's Supplemental Remedial Investigation Memorandum

Based on an evaluation of the groundwater data collected through 2011, three groundwater plumes exist at OU1 (the eastern, central, and western plumes). These plumes are characterized by chlorinated VOCs, primarily PCE and TCE, and are generally oriented in a south-southwest direction, consistent with regional groundwater flow. A downward hydraulic gradient appears to drive the three plumes to greater depths as groundwater moves through the area downgradient of the NCIA. The OU1 eastern and OU1 western plumes are more extensive laterally than the OU1 central plume. The nature and extent of the three contaminant plumes within OU1 are depicted on Figure 2 in Appendix I.

The OU1 eastern plume is characterized by a generally higher molar fraction[6] of PCE relative to TCE at depths less than approximately 205 feet. During the April 2011 pre-design investigation sampling, the highest concentrations of PCE and TCE 16,000 micrograms per liter (µg/L) and 1,800 µg/L, respectively, in the 119-129 feet bgs depth interval. The monitoring well location with the highest concentrations (FSMW-14A) is located approximately 500 feet south of Old Country Road in the northern portion of the OU1 eastern plume area. This monitoring well was installed by a NCIA party in 2004 and has revealed concentrations of PCE up to 75,000 µg/L in the past.

The OU1 central plume is characterized by the highest observed concentrations of TCA within OU1. The highest concentration of TCA (1,400 µg/L) was detected in 2008 at a depth of 105 to 125 feet bgs. The presence of TCA in the OU1 central plume can be used as a contaminant fingerprint to distinguish between the plumes within OU1.

The OU1 central plume is also characterized by a generally higher molar fraction of TCE and cis-1,2- dichloroethene (cis-1,2-DCE) compared to PCE. The highest concentrations of TCE, cis-1,2 DCE, and PCE were observed in 2008 during the first pre-design investigation. At 185 feet bgs, TCE was detected at a concentration of 900 µg/L. At 205 feet bgs, cis-1,2-DCE was detected at a concentration of a 150 µg/L. At 165 feet bgs, PCE was detected at a concentration of a 130 µg/L. At depths greater than approximately 150 feet bgs, PCE and TCE in the OU1 central plume appear to be commingled with the OU1 western plume.

The OU1 western plume is characterized by a generally higher molar fraction of TCE compared to PCE. The highest concentration of TCE (5,100 µg/L) was detected in 2008 at a depth of 225 feet bgs. The highest concentration of PCE (3,700 µg/L) was also detected in 2008 at a depth of 225 feet bgs. The results of the TMW, which was extended down to 502 feet bgs, did not reveal concentrations of PCE and TCE deeper than 450 feet in the western plume downgradient of the NCIA.

5.9 Contaminant Fate and Transport

Discharge of liquid chlorinated VOCs can contaminate groundwater when released into the subsurface via disposal methods such as a dry well or leaching pools. Chlorinated VOCs, such as

[6] The molar fraction is the amount of a chlorinated VOC divided by the total amount of total chlorinated VOCs. This fraction has been adjusted for molecular weight.

PCE and TCE, can migrate downward through the unsaturated zone in a relatively linear pattern with minimal dispersion from the discharge location if unimpeded by low-permeability layers of clays and silts in the subsurface. Natural processes such as percolation of rainfall through the soils to groundwater can facilitate the vertical migration of chlorinated VOCs in the subsurface. Once a liquid chlorinated VOC moves through the unsaturated subsurface and encounters the water table, it will typically dissolve into the groundwater to a degree depending on its solubility. Chlorinated VOCs in the dissolved phase are weakly adsorbed to the soil material and tend to move with groundwater flow, although generally not at the same rate because of the physical and chemical characteristics of the aquifer system. Over time, these dissolved chlorinated VOCs can continue to migrate extensively vertically and horizontally through the subsurface.

The presence and migration of dissolved phase chlorinated VOC contamination in OU1 is evident based on results from past sampling events taken from the monitoring well network within OU1. Three plumes have been observed within OU1: the OU1 eastern, OU1 central and OU1 western plumes. Previous investigations have revealed that dissolved chlorinated VOCs have migrated south of Old Country Road approximately 1,800 feet south in the OU1 western plume area, 800 feet south in the OU1 central plume area, and 1,200 feet in the OU1 eastern plume area. Contamination appears to migrate deeper as the distance along each plume axis increases in distance from the northern boundary (Old Country Road) of OU1. A natural downward gradient across OU1 is enhanced by the almost continuous pumping of the Bowling Green water supply wells. Past sampling results from permanent monitoring wells have revealed that dissolved chlorinated VOC levels at concentrations greater than 100 μg/L have migrated vertically to depths up to 285 feet bgs. A previous sampling investigation installed two temporary monitoring wells at a depth of 502 feet bgs, and it revealed the presence of dissolved chlorinated VOCs up to or close to the depth of the temporary monitoring well.

Depending on the quantity released into the subsurface, not all chlorinated VOCs will dissolve completely. Undissolved chlorinated VOCs will continue to move downward through the subsurface under the force of gravity as a Dense Nonaqueous Phase Liquid (DNAPL). DNAPLs are chemicals or mixtures of chemicals that are both heavier than water and only slightly soluble in water (*e.g.*, pure phase PCE and TCE). There is a potential for the presence of DNAPL in limited areas of OU1. Recent sampling results at a monitoring well in the northern portion of the OU1 eastern plume area revealed high concentrations of PCE up to a 16,000 μg/L, indicative of DNAPL. A review of past groundwater sampling events overseen by a NCIA party at this monitoring well location reveals that higher concentrations of PCE (up to a 75,000 μg/L) have been observed.

6. CURRENT AND POTENTIAL FUTURE LAND USES

6.1 Land Use

The land use pattern within OU1 is one of high/dense land use and development, with large areas of impervious surfaces and little remaining natural areas. The OU1 area contains mostly residential parcels, two schools, and some commercial/retail space (banks, food and retail shops, office space). The Bowling Green water supply wells are located within OU1, south of Old County Road. Nassau County Basin 51, a storm water detention/recharge basin, is located adjacent to the Bowling Green treatment plant. Another smaller recharge basin operated by Nassau County Department of Public Works is located south of Old County Road and just north of the local middle and high school. W.T. Clarke Middle School and High School intercept the southwest boundary edge of the OU1 area. A few county facilities including the Nassau County Family Court and the Family Assistance Center are located on the northeastern portion of OU1 along Carman Avenue.

6.2 Groundwater Use

Water use on Long Island is dependent on the aquifers underlying the island. These aquifers, including the UGA, Magothy, and Lloyd, comprise a system of sole or principal source aquifers that are defined by the EPA as supplying at least 50% of drinking water consumed in the area overlying the aquifers[7]. The aquifers underlying Long Island, composed primarily of sand and gravel mixed with lesser amounts of silt and clay, are particularly susceptible to contamination through both the horizontal and vertical migration of contaminants.

Adjacent to the OU1 central plume area boundary, the Bowling Green Water Supply District maintains a water supply plant and well field (with the Bowling Green 1 and Bowling Green 2 production wells). The Bowling Green Water Supply District, as well as numerous other distribution systems, provides potable water to a portion of Nassau County. The Bowling Green water supply wells 1 and 2 are screened in the Magothy aquifer at approximately 470-530 and 520-580 feet bgs, respectively. An engineering control, which includes a GAC and an air stripping system, is in place at the Bowling Green treatment plant to treat extracted groundwater before distribution to the public. Within OU1, the area serviced by municipal water system(s), no private drinking water wells are known to exist.

7. SUMMARY OF SITE RISKS

As part of the CERCLA remedy selection process, the EPA conducted a baseline human health risk assessment (HHRA) for groundwater at OU1 to estimate current and future effects of contaminants on human health (New York state-law cleanup decisions do not require risk assessments of this type). A HHRA is an analysis of the potential adverse human health effects caused by hazardous-substance exposure in the absence of any actions to control or mitigate these exposures under current and future land uses. It can provide the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by a remedial action. Section 7 of the ROD summarizes the results of the HHRA for OU1. Tables 1 through 6 in Appendix II present the relevant subset of information from the HHRA. The HHRA for OU1 at the Site, entitled *Final Baseline Human Health Risk Assessment*, prepared by Henningson, Durham & Richardson, Inc. (HDR) for U.S. Army Corps of Engineers, May 2013, is available in the Administrative Record.

A screening level ecological risk assessment, which assesses the risk posed to ecological receptors, was not conducted because contaminated groundwater downgradient of NCIA does not discharge to surface water bodies within OU1. Because no groundwater discharges to surface water, exposure pathways are not compromised, and ecological receptors are not exposed to contaminants from OU1.

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[7] http://www.epa.gov/Region2/water/aquifer/

7.1 Human Health Risk Assessment

A four-step process is utilized for assessing site-related human health risks for reasonable maximum exposure scenarios. The four-step process is described below.

Hazard Identification: In this step, the contaminants of potential concern (COPCs) at a site in various media (*i.e.*, groundwater in this case) are identified based on such factors as toxicity, frequency of occurrence, fate and transport of the contaminants in the environment, concentrations of the contaminants in specific media, mobility, persistence, and bioaccumulation.

Exposure Assessment: In this step, the different exposure pathways through which people might be exposed to the contaminants identified in the previous step are evaluated. Examples of exposure pathways include incidental ingestion of, inhalation of, and dermal contact with contaminated groundwater. Factors relating to the exposure assessment include, but are not limited to, the concentrations to which people may be exposed and the potential frequency and duration of exposure. Using these factors, a reasonable maximum exposure scenario, which portrays the highest level of human exposure that could reasonably be expected to occur, is calculated.

Toxicity Assessment: In this step, the types of adverse health effects associated with contaminant exposures and the relationship between magnitude of exposure and severity of adverse health effects are determined. Potential health effects are contaminant-specific and may include the risk of developing cancer over a lifetime or other noncancer health effects, such as changes in the normal functions of organs within the body (*e.g.*, changes in the effectiveness of the immune system). Some contaminants are capable of causing both cancer and noncancer health effects.

Risk Characterization: In this last step, outputs of the exposure and toxicity assessments are summarized and combined to provide a quantitative assessment of site-related risks. During this step, contaminants with concentrations that exceed federal Superfund guidelines for acceptable exposure are identified. These guidelines are 10^{-4} to 10^{-6}, or one-in-ten-thousand to one-in-a-million excess occurrences for cancer, and a hazard index (HI) of greater than 1.0 for noncancer health hazards. Chemicals with concentrations that exceed these guidelines are then considered chemical of concern (COCs) for the site and are typically those that will require remediation. The uncertainties associated with the risk calculations are also evaluated under this step.

The following subsections summarize the components of the HHRA with respect to the basic steps in the Superfund Risk Assessment process: 1) Hazard Identification; 2) Exposure Assessment; 3) Toxicity Assessment; and 4) Risk Characterization. These steps, as applied to OU1 of the Site, are described below.

7.1.1 Hazard Identification

The HHRA quantitatively assessed a groundwater dataset that included samples from 38 combined monitoring well locations collected in both April 2011 and February 2008 during pre-design investigations conducted on behalf of NYSDEC. The groundwater dataset consisted of VOC analysis from permanent monitoring wells within OU1 only. An evaluation of data usability concluded that the analytical groundwater data were suitable for use in the HHRA.

During the hazard identification process, the COPCs in OU1 groundwater were identified based on factors such as toxicity, frequency of occurrence, fate and transport of the contaminants in the environment, concentrations, mobility persistence, and bioaccumulation. Fifteen VOCs were identified as COPCs and included: TCA; 1,1,2,2-tetrachloroethane; 1,1,2-TCA; 1,1-DCA; 1,1-DCE; 1,2-DCA; benzene; bromodichloromethane; carbon tetrachloride; chloroform; cis-1,2-DCE; PCE; trans-1,2-DCE; TCE; and vinyl chloride.

The exposure point concentration (EPC) is the concentration of a constituent in a given environmental medium at the point of human contact. Estimates of the EPC represent the concentration term used in the exposure assessment component of the quantitative risk evaluation. Groundwater EPCs for COCs, or those chemicals requiring remediation at OU1 of the Site, are provided in Table 1.

7.1.2 Exposure Assessment

In this step of the HHRA, the different exposure scenarios and pathways through which people might be exposed to the contaminants identified in the previous step are evaluated. Consistent with Superfund policy and guidance, the HHRA is a baseline human health risk assessment, and, therefore, assumes no remediation or institutional controls to mitigate or remove hazardous substance releases. Cancer risks and noncancer hazard indices were calculated based on an estimate of the reasonable maximum exposure (RME) expected to occur under current and future conditions at the site. The RME is defined as the highest exposure that is reasonably expected to occur at a site.

The area encompassing OU1 mainly consists of residential parcels with some retail businesses along Old Country Road. Portions of the W.T. Clarke Middle School and High School are within the southwest corner of OU1. The Bowling Green water supply wells, Nassau County Storm Water Basin 51, and another smaller Nassau County Department of Public Works-operated recharge basin are located within the area. It is expected that the future land and groundwater use in this area will remain the same.

Based on current zoning and anticipated future use of OU1, the HHRA focused on two future receptors: residents and commercial/industrial workers exposed to groundwater. Current exposure to contaminated groundwater at OU1 of the Site is not a completed exposure pathway because all the receptors in the vicinity of OU1 are connected to the municipal water supply which is treated before distribution. As shown in Table 2, exposure pathways considered for the future commercial/industrial workers include ingestion and dermal contact with groundwater, while the exposure pathways for the future resident (child and adult) included ingestion, dermal contact, and inhalation of volatiles while bathing/showering.

Additionally, as part of the HHRA, a qualitative screening assessment was conducted to determine if the potential for vapor intrusion into indoor air exists. The groundwater to vapor exposure pathway was evaluated qualitatively by comparing the maximum detected VOC concentration in groundwater to chemical-specific, risk-based groundwater screening levels provided in the EPA's Vapor Intrusion Screening Level Calculator (VISL)[8]. These screening

[8] EPA's Office of Solid Waste and Emergency Response's Vapor Intrusion Assessment Tool, the Vapor Intrusion

levels in the VISL are set at the target threshold values which correlate to an indoor air concentration representing a cancer risk of 1 x 10^{-6} or a noncancer hazard quotient of 1. Any chemical exceeding the groundwater screening value was identified as a potential vapor intrusion-related COPCs. The following twelve vapor intrusion-related COPCs were identified: 1,1,2,2-tetrachloroethane; 1,1,2-TCA; 1,1-DCA; 1,1-DCE; 1,2-DCA; benzene; bromodichloromethane; carbon tetrachloride; chloroform; PCE;TCE; and vinyl chloride.

The qualitative screening level evaluation indicated that the potential for vapor intrusion exists at OU1 of the Site. While the EPA has not conducted any vapor intrusion sampling at OU1 to date, the EPA's HHRA for OU1 did summarize the vapor intrusion sampling that was conducted by NYSDEC from 2006 to 2009. Results from NYSDEC's vapor intrusion investigation, which included sampling of seven residences, did not indicate the need for installation of vapor intrusion mitigation systems. Further discussion of NYSDEC's results and a comparison with the EPA's current vapor intrusion screening levels can be found in Section 5 of the *Final Baseline Human Health Risk Assessment*, prepared by HDR Inc. for U.S. Army Corps of Engineers, May 2013, available in the Administrative Record.

7.1.3 Toxicity Assessment

The toxicity assessment determines the types of adverse health effects associated with exposure to COPCs and the relationship between the magnitude of exposure (dose) and severity of adverse effect (response). Potential health effects are contaminant specific and may include the risk of developing cancer over a lifetime or other noncancer health effects, such as changes in the normal functions of organs within the body (*e.g.*, changes in the effectiveness of the immune system). Some contaminants are capable of causing both cancer and noncancer health effects.

Under the EPA guidelines, the likelihood of carcinogenic risks and noncancer hazards as a result of exposure to site chemicals are considered separately. Consistent with current the EPA policy, it was assumed that the toxic effects of the site-related chemicals would be additive.

Thus, cancer and noncancer risks associated with exposures to individual COPCs were added to indicate the potential risks and hazards associated with mixtures of potential carcinogens and noncarcinogens, respectively. Toxicity data for the HHRA were provided by the Integrated Risk Information System database, the Provisional Peer Reviewed Toxicity Database, or another source that is identified as an appropriate reference for toxicity values consistent with the EPA's directive on toxicity values. This information is presented in Table 3 (noncancer toxicity data summary) and Table 4 (cancer toxicity data summary). Additional toxicity information for all COPCs is presented in the baseline HHRA.

7.1.4 Risk Characterization

The final step in the HHRA combines the exposure and toxicity information to provide a quantitative assessment of site risks. Exposures are evaluated based on the potential risk for developing cancer and the potential for noncancer health hazards.

Screening Level Calculator (Version 3.0, November 2012) was used to assess the potential for vapor intrusion at OU1.

Noncancer Health Hazards

For noncancer health effects, a HI is calculated. The HI is determined based on a comparison of expected contaminant intakes and benchmark comparison levels of intake (reference doses, reference concentrations). Reference doses (RfDs) and reference concentrations (RfCs) are estimates of daily exposure levels for humans (including sensitive individuals) which are thought to be safe over a lifetime of exposure. The estimated intake of chemicals identified in environmental media (*e.g.*, the amount of chemical ingested from contaminated drinking water) is compared to the RfD or the RfC to derive the hazard quotient (HQ) for the contaminant in the particular medium. The HI is obtained by adding the hazard quotients for all compounds within a particular medium that impacts a particular receptor population.

The HQ for oral and dermal exposures is calculated as below. The HQ for inhalation exposures is calculated using a similar model that incorporates the RfC, rather than the RfD.

HQ = Intake/RfD

where:
HQ = hazard quotient
Intake = estimated intake for a chemical (milligram (mg)/kilogram (kg)-day)
RfD = reference dose (mg/kg-day)

The intake and the RfD will represent the same exposure period (*i.e.*, chronic, subchronic, or acute).

The key concept for a noncancer HI is that a "threshold level" (measured as an HI of less than 1) exists below which noncancer health effects are not expected to occur. The HI is calculated by summing the HQs for all chemicals for likely exposure scenarios for a specific population. An HI greater than 1.0 indicates that the potential exists for noncarcinogenic health effects to occur as a result of site-related exposures, with the potential for health effects increasing as the HI increases. When the HI calculated for all chemicals for a specific population exceeds 1.0, separate HI values are then calculated for those chemicals which are known to act on the same target organ. These discrete HI values are then compared to the acceptable limit of 1.0 to evaluate the potential for noncancer health effects on a specific target organ. The HI provides a useful reference point for ascertaining the potential significance of multiple contaminant exposures within a single medium or across media.

As summarized in Table 5, the HI for noncancer effects exceeded the EPA's threshold value of 1 for the future adult resident (HI of 300) and child resident (HI of 700). The primary contributors (*i.e.*, COCs) to this hazard level were TCE, PCE, cis-1,2-DCE, 1,1,2- trichloroethane, and 1,1-DCE. In addition, noncancer health effects exceeded the EPA's threshold value of 1 for the future commercial/industrial worker with a HI of 20. The primary contributors to this hazard level were TCE and PCE.

Cancer Risks

Cancer risk is expressed as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a carcinogen using the cancer slope factor (SF) for oral and dermal exposures and the inhalation unit risk (IUR) for inhalation exposures. Excess lifetime cancer risk for oral and dermal exposure is calculated from the following equation, while the equation for inhalation exposure uses the IUR, rather than the SF:

Risk = LADD x SF

where:

Risk	=	a unitless probability (*e.g.*, 1×10^{-6} of an individual developing cancer)
LADD	=	Lifetime Average Daily Dose averaged over 70 years (mg/kg-day)
SF	=	Cancer Slope Factor, expressed as $(mg/kg\text{-}day)^{-1}$

The likelihood of an individual developing cancer is expressed as a probability that is usually expressed in scientific notation (such as 1×10^{-4}). For example, a 10^{-4} cancer risk means a "one in 10,000 excess cancer risk," or an increased risk of an individual developing cancer of one in 10,000 as a result of exposure to site contaminants under the conditions used in the Exposure Assessment. Under the federal Superfund program, the EPA's goal of protection is an excess cancer risk of 10^{-6} (one in 1,000,000) or less for the RME individual. Acceptable cancer risks, established under the NCP, are an individual lifetime excess cancer risk at or below the range of 10^{-4} to 10^{-6}.

As summarized in Table 6, the estimated cancer risks for future residents (child and adult) and commercial/industrial workers in the OU1 area exceed the EPA's target risk range of 1×10^{-6} to 1×10^{-4}. The estimated cancer risk for a future resident exposed to groundwater is 3×10^{-3}, with the primary risk drivers (*i.e.,* COCs) identified as PCE, TCE, vinyl chloride, 1,1-DCA, chloroform, and 1,1,2,2-tetrachloroethane. The estimated cancer risk for a future site worker exposed to groundwater at OU1 of the site was 2×10^{-4}.

<u>Uncertainties</u>

The procedures and inputs used to assess risks in this evaluation are subject to a variety of uncertainties. In general, the main sources of uncertainty include the following: environmental chemistry sampling and analysis, risk characterization, fate and transport modeling, receptor exposure assessment, and toxicological data/assessment.

Uncertainty in environmental sampling arises in part from the potentially uneven distribution of chemicals as to the actual levels present. Environmental chemistry-analysis error can stem from several sources, including the errors inherent in the analytical methods and characteristics of the matrix being analyzed. The data used in the risk assessment included only VOCs, and, therefore, did not account for other parameters which could potentially underestimate groundwater risks and hazards.

Uncertainties in the exposure assessment are related to estimates of how often an individual would actually come in contact with the COCs, the period over which such exposure would occur, and in the models used to estimate the concentrations of the COCs at the point of exposure.

Uncertainties in toxicological data occur in extrapolating both from animals to humans and from high to low doses of exposure, as well as from the difficulties in assessing the toxicity of a mixture of chemicals. These uncertainties are addressed by making conservative assumptions concerning risk and exposure parameters throughout the assessment. As a result, the risk assessment provides upper-bound estimates of the risks to populations at OU1, and it is highly unlikely to underestimate actual risks related to OU1 of the Site.

Additionally, there is uncertainty because of the lack of 1,4-dioxane data that was available in the 2008 to 2011 groundwater monitoring well data set. 1,4-dioxane is a VOC that is a potential human carcinogen, and its exclusion based on lack of data presents uncertainty as its exclusion could potentially underestimate the overall risk from exposure to OU1 groundwater.

More specific information concerning public health risks, including a quantitative evaluation of the degree of risk associated with various exposure pathways is presented in the risk assessment report.

7.2 Risk Characterization Conclusions

A quantitative assessment of receptors under the future scenario indicated unacceptable noncancer hazard and cancer risk to human health due to the presence of VOCs in groundwater at OU1 of the Site. The estimated cancer risks for future site workers of 2×10^{-4} and future residents of 3×10^{-3} at OU1 exceed the EPA's target risk range. Additionally, estimated noncancer HI for the future site workers (20), future child (700) and adult residents (300) at OU1 exceed the EPA's target threshold of 1. In sum, the COCs based on noncancer and cancer health effects are: TCE, PCE, cis-1,2-DCE, 1,1-DCE, vinyl chloride, 1,1,2- TCA, 1,1,2,2-tetrachloroethane, 1,1-DCA, and chloroform.

7.3 Basis for Taking Action

Based on the results of the quantitative HHRA, the EPA has determined that actual or threatened releases of hazardous substances from OU1 of the Site, if not addressed, may present a threat to human health. It is the EPA's current judgment that the response action identified in this ROD is necessary to protect public health or welfare from actual or threatened releases of hazardous substances into the environment.

8. REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) are specific goals to protect human health and the environment. These objectives are based on available information and standards, such as applicable or relevant and appropriate requirements (ARARs), to-be-considered (TBC) guidance, and site-specific risk-based levels established using the risk assessments.

The following RAOs have been established to address groundwater contamination for OU1 of the Site:

- Prevent or minimize current and potential future human exposure (via ingestion, dermal contact, and inhalation) to VOCs in groundwater at concentrations in excess of federal MCLs and state standards;

- Minimize the potential for further migration of groundwater with VOC contaminant concentrations greater than federal MCLs and state standards; and

- Restore the impacted aquifer to its most beneficial use as a source of drinking water by reducing contaminant levels to the federal MCLs and state standards.

The cleanup goals for the groundwater COCs and their basis are presented in Table 7.

9. DESCRIPTION OF ALTERNATIVES

CERCLA Section 121(b)(1), 42 U.S.C. § 9621(b)(1), requires remedial actions to be protective of human health and the environment, be cost-effective, and utilize permanent solutions and alternative treatment technologies and resource recovery alternatives to the maximum extent practicable. CERCLA Section 121(b)(1) also establishes a preference for remedial actions which employ, as a principal element, treatment to permanently and significantly reduce the volume, toxicity, or mobility of the hazardous substances, pollutants and contaminants at a site. Further, CERCLA Section 121(d), 42 U.S.C. § 9621(d), specifies that a remedial action must attain a level or standard of control of the hazardous substances, pollutants, and contaminants, which at least attains ARARs under federal and state laws, unless a waiver can be justified pursuant to CERCLA Section 121(d)(4), 42 U.S.C. § 9621(d)(4).

Detailed descriptions of the remedial alternatives considered for addressing groundwater contamination at OU1 can be found in the EPA's OU1 Supplemental Feasibility Study (FS) Memorandum. The EPA's OU1 Supplemental FS Memorandum updates information previously presented in NYSDEC's study for "New Cassel Industrial Area Off-site Groundwater," dated September 2000, and it introduces three additional alternatives. Based on evaluations performed by the EPA in the development of the OU1 Supplemental FS Memorandum, remedial alternatives developed by NYSDEC in 2000 for its remedy that do not address the entire vertical extent of groundwater contamination were not considered satisfactory alternatives and are not included among the EPA's alternatives for this remedy.

The construction time for each alternative reflects only the time required to construct the remedy and does not include the time required to design the remedy, actually attain performance standards, negotiate the performance of the remedy with any potentially responsible parties, or procure contracts for design and construction.

9.1 Description of Common Elements among Remedial Alternatives

All of the alternatives, with the exception of Alternative 1 and the other exceptions noted, below, include certain common components. Alternatives 2 through 5 include long-term monitoring as part of operations and maintenance (O&M) activities to confirm that groundwater quality improves following implementation of the selected alternative until performance standards are achieved. The long-term monitoring program would include sampling from the two existing, early-warning monitoring well clusters and an evaluation of potential impacts on the Bowling Green water supply wells. Also, as additional groundwater data become available, the EPA would continue to investigate the soil vapor intrusion pathway for OU1 under alternatives 2 through 5. Vapor mitigation systems would be installed, if warranted.

Alternatives 2, 3, 4, and 5 include institutional controls for groundwater use restrictions until performance standards are achieved; a plan would be developed which would specify those institutional controls to ensure that the remedy is protective. Any existing local requirements that prevent installation of drinking water wells and informational devices to limit exposure to contaminated groundwater would be implemented.

Alternatives 3, 4, and 5, all of which include active remediation, would evaluate the use of in-situ chemical treatments such as in-situ chemical oxidation (ISCO) to target areas containing high concentrations (greater than a 10,000 μg/L) of total VOCs. ISCO is a process that involves the injection of reactive chemical oxidants into the subsurface for rapid contaminant destruction. Oxidation of organic compounds using ISCO converts contaminants to nontoxic by-products. During the remedial design, a treatability study would be performed to evaluate the use of in-situ chemical treatments, such as ISCO, as an element of the selected alternative, in a manner that complements and improves the effectiveness of the remedy. In-situ chemical treatment would only be utilized if a determination is made during the remedial design that the application would not adversely affect the public supply wells.

Additionally, because it will take longer than five years to achieve RAOs, in alternatives 2 through 5 include, a review of conditions at the Site to be conducted no less often than once every five years until cleanup levels are achieved. Alternative 1, No Further Action, would also necessitate a review of conditions no less often than once every five years as contaminants above the MCL would be present at OU1 of the Site.

9.2 Description of Remedial Alternatives

Alternative 1: No Further Action

Capital Cost:	$0
Annual O&M Costs (present-worth):	$0
Present-Worth Cost:	$0
Construction Time:	0 years

The NCP requires that a "No Action" alternative be considered as a baseline for comparison with other remedial alternatives. Under this alternative, there would be no physical remedial actions taken to address contamination. Additionally, this alternative does not include monitoring or institutional controls.

Under this alternative, CERCLA requires that the Site would be reviewed at least once every five years as long as contaminants remain above the levels that allow for unrestricted use and unlimited exposure. If justified by the review, additional response actions may be implemented.

Alternative 2: Monitored Natural Attenuation

Capital Cost:	$614,000
Annual O&M Costs (present-worth):	$115,000
Present-Worth Cost:	$3,300,000
Construction Time:	6 to 9 months

This remedial alternative relies on monitored natural attenuation (MNA) to address the groundwater contamination. Natural attenuation is the process by which contaminant concentrations are reduced by various naturally occurring physical, chemical, and biological processes. The main processes include biodegradation, dispersion, dilution, sorption, volatilization, and chemical or biological stabilization, transformation, or destruction of contaminants. These processes occur naturally, in-situ, and act to decrease the mass or concentration of contaminants in the subsurface. Only non-augmented, natural processes are relied upon under this alternative.

Implementation of this alternative includes the installation of additional monitoring wells, periodic sample collection and analysis, data evaluation, and contaminant trend analysis. Under this alternative, a network of approximately 33 groundwater monitoring wells (21 existing and 12 to be installed) would be monitored for MNA parameters, which would include groundwater quality. The conceptual sampling schedule used for this alternative assumes 24 groundwater monitoring wells sampled quarterly for the first two years, semi-annually for the next three years, and annually thereafter.

An estimated remediation time frame of 30 years is used for estimating costs associated with O&M activities. The time frame to meet groundwater RAOs in OU1 is difficult to predict because the EPA's Supplemental FS Memorandum did not include modeling to estimate remediation time frames. However, under this alternative, it is anticipated that RAOs would not be achieved in a reasonable time frame based on Site-specific conditions.

This alternative includes long-term monitoring to confirm that groundwater quality improves following implementation of the selected remedy until performance standards are achieved. As additional groundwater data become available, the EPA would continue to investigate the soil vapor intrusion pathway for OU1 under Alternative 2. Additionally, in accordance with CERCLA, a review of conditions at the Site will be conducted no less often than once every five years until RAOs are achieved. As discussed earlier, this alternative would also include the common element of institutional controls.

Alternative 3: In-well Vapor Stripping; In-Situ Chemical Treatment

Capital Cost:	$11,728,000
Annual O&M Costs (present-worth):	$652,000
Present-Worth Cost:	$24,000,000
Construction Time:	1 to 2 years

This remedial alternative includes the installation of in-well vapor-stripping systems in groundwater at various depths to provide contaminant mass removal and containment at OU1.

In-well vapor stripping is a technology that uses the principles of phase separation to transfer VOCs from the liquid to gas phase by aerating the contaminated water in the wellhead. Aeration can be accomplished by either injecting air into the water table or by using an air stripper mounted at the well head. Typically, extracted vapors are treated (as necessary) above-grade and discharged to the atmosphere. Vapor treatment, if required, generally consists of vapor-phase GAC.

The in-well vapor-stripping well is a closed system where the contaminated groundwater is never exposed at the ground surface or to the atmosphere. Typically impacted groundwater is pumped to the well head where it is treated and discharged or directly discharged back into the well. Once treated, the groundwater flows back into the aquifer through screens in the well that are typically located at the water table (unsaturated zone) but can also be located beneath the water table (saturated zone). In some in-well vapor-stripping well configurations, the extraction and re-injection of groundwater from the aquifer induces a hydraulic circulation pattern that allows continuous cycling of groundwater through the treatment well. As groundwater circulates through the treatment system in-situ and vapor is extracted, the contaminant concentrations in the groundwater are reduced.

In-well vapor stripping can be implemented in different system configurations. For the purposes of developing a conceptual design and cost estimate for comparison with other technologies in the OU1 Supplemental FS Memorandum, wells were configured centrally along the OU1 eastern, central and western plume areas to provide mass removal. Wells were additionally placed perpendicular to groundwater flow along each of the OU1 plumes at the 100 μg/L total VOC contour to provide containment, treatment, or both of the plume areas. This conceptual design would necessitate installation of 13 permanent in-well vapor-stripping wells in the OU1 eastern plume area, eight in the OU1 central plume area, and 51 in the OU1 western plume area. The conceptual layout of these 72 wells targets the shallow (< 175 feet bgs), intermediate (175 to 250 feet bgs) and deep (>250 feet bgs) intervals of the aquifer. A centralized treatment building was assumed in the conceptual design for vapor treatment.

In-well vapor stripping would target treatment of groundwater contaminated where the concentration of total VOCs is greater than 100 μg/L, but less than 10,000 μg/L. The remedial design would evaluate the use of in-situ chemical treatments such as ISCO to target areas containing high concentrations (concentrations that are greater than 10,000 μg/L) of VOCs.

An estimated remediation time frame of 30 years is used for developing costs associated with O&M activities. The time frame to meet groundwater RAOs in OU1 is difficult to predict because it is uncertain how quickly groundwater concentrations will decrease as a result of remedial technologies. Active remediation would be employed in the targeted treatment areas until the remediation goal for each of the COCs is attained within the targeted treatment area.

The conceptual design would require further evaluation during the remedial design phase if this alternative is selected. As discussed earlier, this alternative includes the common element of long-term monitoring to confirm that groundwater quality improves following implementation of this alternative until RAOs are achieved. Additional wells would also have to be installed to monitor the progress of the remediation. As additional groundwater data become available, the EPA would continue to investigate the soil vapor intrusion pathway for OU1 under Alternative 3.

Additionally, in accordance with CERCLA, a review of conditions at the Site will be conducted no less often than once every five years until RAOs are achieved. This alternative would also include the common element of institutional controls.

Alternative 4: Groundwater Extraction and Treatment; In-Situ Chemical Treatment

Capital Cost:	$ 8,862,000
Annual O&M Costs (present-worth):	$ 834,000
Present-Worth Cost:	$ 24,200,000
Construction Time:	1 to 2 years

This remedial alternative consists of the extraction of groundwater via pumping wells and treatment on-Site prior to discharge. Groundwater would be pumped and treated to remove contaminant mass from areas of the aquifer with elevated concentrations of VOCs and to provide containment within OU1.

For this conceptual design, it is estimated that 11 extraction wells would be installed in the shallow (< 175 feet bgs), intermediate (175 -250 feet bgs) and deep (>250 feet bgs) intervals of the contaminated portions of the aquifer. The conceptual design contains an estimate of three extraction wells in the OU1 eastern plume area, three in the OU1 central plume area, and five in the OU1 western plume area.

Extraction wells would target treatment of groundwater contaminated with concentrations of total VOCs in excess of 100 µg/L. The remedial design would evaluate the use of in-situ chemical treatments such as ISCO to target areas containing high concentrations (concentrations that are greater than 10,000 µg/L) of VOCs.

Extracted groundwater with VOC contamination is typically treated with either liquid phase GAC or air stripping, or both. Air stripper effluent may be treated with vapor phase GAC, if necessary. Extracted groundwater would be pumped from the network of extraction wells to one centralized treatment system facility with a treatment capacity of approximately 700 gallons per minute (gpm), where groundwater would be treated using both an air stripper and liquid phase GAC. Treated groundwater would then be re-injected back into the UGA using an estimated 20 infiltration wells which would be installed in the vicinity of the Nassau County Recharge Basin #51 parcel. However, during the remedial design phase, an evaluation and determination would be made whether to re-inject the treated water or to discharge it to a publicly owned treatment works (POTW), or some combination thereof. This conceptual design, including the number and placement of the extraction wells, would require further evaluation during the remedial design if this alternative is selected.

An estimated remediation time frame of 30 years is used for developing costs associated with O&M activities. The time frame to meet groundwater RAOs in OU1 is difficult to predict because it is uncertain how quickly groundwater concentrations will decrease as a result of remedial technologies. Active remediation would be employed in the targeted treatment areas until the remediation goal for each of the COCs is attained within the targeted treatment area.

The conceptual design would require further evaluation during the remedial design phase if this alternative is selected. As discussed earlier, this alternative includes the common element of long-term monitoring to confirm that groundwater quality improves following implementation of this alternative until RAOs are achieved. Additional wells would also have to be installed to monitor the progress of the remediation. As additional groundwater data become available, the EPA would continue to investigate the soil vapor intrusion pathway for OU1 under Alternative 4. Additionally, in accordance with CERCLA, a review of conditions at the Site will be conducted no less often than once every five years until RAOs are achieved. This alternative would also include the common element of institutional controls.

Alternative 5: Hybrid Alternative – In-well Vapor Stripping / Groundwater Extraction and Treatment; In-situ Chemical Treatment

Capital Cost:	$ 10,044,000
Annual O&M Costs (present-worth):	$ 680,000
Present-Worth Cost:	$ 22,900,000
Construction Time:	1 to 2 years

This remedial alternative consists of a hybrid, or combination, of Alternative 3 (in-well vapor stripping) and Alternative 4 (groundwater extraction and treatment). This hybrid alternative would provide contaminant mass removal and containment through the implementation of both in-well vapor stripping and groundwater extraction and treatment remedial technologies to address groundwater contamination in OU1.

Under the conceptual design, in-well vapor stripping would target treatment of groundwater in areas where concentrations of total VOCs are greater than 100 µg/L but less than 1,000 µg/L. Groundwater extraction and treatment would target groundwater in areas with concentrations of total VOCs greater than a 1,000 µg/L but less than a 10,000 µg/L. In plume areas where concentrations of total VOCs are greater than a 10,000 µg/L, use of in-situ chemical treatment such as ISCO would be evaluated for implementation.

For this conceptual design, it is estimated that three extraction wells would be installed in the OU1 eastern plume area as total VOC concentrations generally exceed 1,000 µg/L. In the OU1 central plume area where total VOC concentrations are generally less than 1,000 µg/L, eight in-well vapor-stripping wells would be installed. In the OU1 western plume area, a combination of 12 in-well vapor-stripping wells and three extraction wells would be used as the plume area covers a wider area and concentrations are generally less than 1,000 µg/L.

Under this alternative, a centralized treatment plant would be constructed in the vicinity of Nassau County Recharge Basin #51 to treat extracted groundwater and vapors. Extracted groundwater would be pumped to a centralized treatment plant where groundwater would then be treated using both an air stripper and liquid phase GAC. Treated groundwater, after meeting groundwater standards, would then be re-injected back into the UGA using an estimated seven dry wells.

The centralized treatment plant would have the capacity to treat up to 350 gpm. However, during the remedial design, an evaluation and determination would be made whether to re-inject the treated groundwater or discharge it to a POTW, or some combination thereof. For the in-well vapor-stripping wells, extracted vapors are typically treated (if necessary) above grade and discharged to the atmosphere. Vapor treatment, if required, generally consists of vapor-phase GAC, which would be addressed at the centralized treatment plant.

An estimated remediation time frame of 30 years is used for developing costs associated with O&M activities. The time frame to meet groundwater RAOs in OU1 is difficult to predict because it is uncertain how quickly groundwater concentrations will decrease as a result of remedial technologies. Active remediation would be employed in the targeted treatment areas until the remediation goal for each of the COCs is attained within the targeted treatment area.

The conceptual design would require further evaluation during the remedial design phase if this alternative is selected. This alternative includes long-term monitoring to confirm that groundwater quality improves following implementation of this alternative until performance standards are achieved. Additional wells would also have to be installed to monitor the progress of the remediation. As additional groundwater data become available, the EPA would continue to investigate the soil vapor intrusion pathway for OU1 under Alternative 5. Additionally, in accordance with CERCLA, a review of conditions at the Site will be conducted no less often than once every five years until performance standards are achieved. This alternative would also include the common element of institutional controls.

10. COMPARATIVE ANALYSIS OF ALTERNATIVES

In selecting a remedy for a site, the EPA considers the factors set forth in CERCLA Section 121, 42 U.S.C. § 9621, by conducting a detailed analysis of the remedial alternatives introduced in the FS pursuant to the requirements of the NCP at 40 C.F.R. § 300.430(e)(9), the EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies*, OSWER Directive 9355.3-01, and the EPA's *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents*, OSWER 9200.1-23.P. The detailed analysis consists of an assessment of the individual alternatives against each of the nine evaluation criteria set forth at 40 C.F.R. § 300.430(e)(9)(iii) and a comparative analysis focusing upon the relative performance of each alternative against those criteria.

The following **"threshold"** criteria are the most important and must be satisfied by any remedial alternative in order to be eligible for selection:

1. **Overall protection of human health and the environment** addresses whether or not a remedy provides adequate protection and describes how risks posed through each exposure pathway (based on a reasonable maximum exposure scenario) are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

2. **Compliance with ARARs** addresses whether a remedy would meet all of the applicable or relevant and appropriate requirements of other federal and state environmental statutes and regulations or provide grounds for invoking a waiver. Other federal or state advisories, criteria, or guidance are TBCs. While TBCs are not required to be adhered to by the NCP, the NCP recognizes that they may be very useful in determining what is protective of a site or how to carry out certain actions or requirements.

The following **"primary balancing"** criteria are used to make comparisons and to identify the major tradeoffs between alternatives:

3. **Long-term effectiveness and permanence** refers to the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup levels have been met. It also addresses the magnitude and effectiveness of the measures that may be required to manage the risk posed by treatment residuals and/or untreated wastes.

4. **Reduction of toxicity, mobility, or volume through treatment** is the anticipated performance of the treatment technologies, with respect to these parameters, that a remedy may employ.

5. **Short-term effectiveness** addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation of the remedy.

6. **Implementability** is the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option.

7. **Cost** includes estimated capital, O&M, and present worth costs.

The following **"modifying"** criteria are used in the final evaluation of the remedial alternatives after the formal comment period, and they may prompt modification of the preferred remedy that was presented in the Proposed Plan:

8. **State acceptance** indicates whether, based on its review of the RI/FS report, HHRA, and Proposed Plan, the State concurs with, opposes, or has no comments on the proposed remedy.

9. **Community acceptance** refers to the public's general response to the alternatives described in the RI/FS report, HHRA, and Proposed Plan.

A comparative analysis of the alternatives considered in this ROD, based upon the evaluation criteria noted above, follows.

10.1 Overall Protection of Human Health and the Environment

Alternative 1 (no action) does not provide for adequate protection of human health because it does not mitigate potential future risk posed by contaminated groundwater within OU1. Protectiveness under Alternative 2 is achieved through a combination of monitoring naturally occurring processes and the implementation of institutional controls until cleanup levels are achieved. However, Alternative 2 does not prevent the migration of contaminants, and based on the natural attenuation evaluation, there is uncertainty that biodegradation would progress at a rate so that cleanup levels would be achieved in a reasonable timeframe.

Alternatives 3, 4, and 5 include active remedial components that would address groundwater contamination and are intended to restore groundwater quality over the long-term. Alternatives 3, 4, and 5 would also rely on certain natural processes to achieve the cleanup levels for areas not targeted for active remediation.

Protectiveness under Alternatives 3, 4, and 5 requires a combination of activities to reduce contaminant concentrations in groundwater and limit exposure to residual contaminants through maintenance of any existing institutional controls which restrict groundwater use. Institutional any are anticipated to include existing governmental controls, such as well permit requirements regarding groundwater use in the impacted area. A plan would be developed which would specify institutional controls to ensure that the remedy is protective.

10.2 Compliance with ARARs

The list of chemical-specific, location-specific, and action-specific ARARs can be found in Tables 8, 9, 10, respectively, in Appendix II of this ROD.

The EPA has promulgated health-based protective MCLs (40 CFR Part 141,), which are enforceable standards for various drinking water contaminants (and are chemical-specific ARARs). NYSDOH has promulgated health-based protective standards (10 NYCRR § 5-1.51 Chapter 1). If more than one such requirement applies to a contaminant, compliance with the more stringent ARAR, TBC or guidance is required. The aquifer at the Site is classified as Class GA (6 NYCRR 701.18), which means that the groundwater is designated as a potable drinking water supply. As groundwater within OU1 is a source of drinking water, the MCLs are ARARs and need to be achieved.

Alterative 1, no action, would comply with location- and action-specific ARARs as no work would be conducted. However, Alternative 1 inherently does not include the measures to determine if chemical-specific ARARs have been met. Under Alternative 2, it is not anticipated that chemical-specific ARARs would be achieved in a reasonable time frame as data collected to date has not indicated that complete biodegradation of PCE/TCE is progressing at a significant rate. Thus, degradation of the contaminants throughout the plume to levels which achieve ARARs is likely to exceed a reasonable time. While no single definition of a reasonable timeframe exists, the EPA, pursuant to CERCLA and the NCP, considers various factors when evaluating what is a reasonable time frame for achieving groundwater restoration cleanup levels. For example, when the contaminated groundwater is not currently used, is being treated for contamination, or is an alternate water source is readily available, it would likely be appropriate to consider a longer time-frame for achieving restoration cleanup levels.

An estimated remediation time frame of 30 years was used for developing costs associated with O&M activities for Alternatives 3, 4 and 5. The time frame to meet groundwater RAOs in OU1 is however, difficult to predict because it is uncertain how quickly groundwater concentrations will decrease as a result of implementing the various remedial technologies. Given the successful application of the remedial technologies at other sites, and the response times seen at other Long Island Superfund sites within the same sandy aquifer, it is not unreasonable to expect that the RAOs would be achieved within a 30 year time frame. Active remediation under Alternatives 3, 4, and 5 would be employed in the targeted treatment areas until the remediation goal for each of the COCs is attained within the targeted treatment area. Alternatives 3, 4, and 5 would comply with location-and action-specific ARARs. Chemical-specific ARARs would also be attained for each of these alternatives through treatment.

10.3 Long-Term Effectiveness and Permanence

Alternative 1 does not provide long-term effectiveness or permanence because no active remedial measures are proposed. The EPA has determined that, due to the uncertainty surrounding the data for MNA within OU1, Alternative 2 would not provide long-term effectiveness or permanence at this portion of the Site. In-well vapor stripping under Alternative 3, extraction and treatment under Alternative 4, and a combination of those technologies under Alternative 5 are considered effective technologies for treatment and/or containment of contaminated groundwater under appropriate circumstances, if designed and constructed properly.

Alternatives 3, 4, and 5 rely on a combination of treatment and institutional controls. Institutional controls are anticipated to include any existing governmental controls, such as well permit requirements regarding groundwater use in the impacted area.

Alternative 3, in-well vapor stripping, is expected to be effective and reliable in significantly removing VOC contamination in groundwater. However, the effectiveness of this technology when applied to areas with high levels of VOC concentrations and at significant depth has been limited. The effectiveness of this alternative is limited by the radius of influence (ROI) or "reach" into the aquifer. The ROI will depend on pumping capacity of each stripping well and hydrogeologic characteristics of the groundwater in OU1 area. The ability to secure access to residential properties may impact the optimal placement of the in-well vapor stripping wells. Effectiveness could also be limited because it is possible that creation of a circulation cell may not be feasible. Treatment may not be accomplished in one pass, or additional measures may be needed to provide multiple passes through the treatment system. These additions may require not only vertical but horizontal space that may not be available because of the presence of existing subsurface utilities. A pilot study would be needed to determine pre-design parameters, such as the actual ROI, optimal well spacing, depth to the treatment zone, flow rates, and pumping capacity prior to full-scale implementation. In order to assess the effectiveness of Alternative 3 additional measurements of the aquifer's anisotropy would also be needed.

Alternative 4 would be more reliable than Alternative 3 because there is uncertainty about whether in-well vapor stripping could effectively remove contamination in all of the targeted areas, particular those areas with high total VOC concentrations or in areas where the contamination is at significant depths. Alternative 4 is a proven and effective technology that has been utilized at other Superfund sites on Long Island, New York.

Alternative 5 allows for a combination of both in-well vapor stripping and extraction/treatment technologies to treat the OU1 plume areas. In the OU1 central plume area, where the contaminant plume is generally less extensive laterally and vertically with lower concentrations of total VOCs, in-well vapor stripping is expected to be effective. In the OU1 eastern and a portion of the western plume, where the plume is present at deeper depths and higher concentrations, use of extraction and treatment is anticipated to be more effective, as it is a proven technology which is effective at reducing contaminant mass in such conditions. Alternative 5 provides the capability to effectively target use of either of these two technologies to treat and contain contamination throughout different horizontal and vertical hydraulic and contaminant gradients.

10.4 Reduction in Toxicity, Mobility, or Volume through Treatment

Alternative 1 does not address contamination through treatment as no action would be taken. Additionally, Alternative 1 does provide the means to asses a reduction in toxicity, mobility or volume through treatment (TMV). Alternative 2 would be similar to Alternative 1, in that naturally occurring processes to degrade contaminants would be the only means to reduce TMV. However, Alternative 2 does include monitoring requirements to evaluate the reduction, although evaluations to date suggest that conditions in the aquifer are not conducive to the timely degradation of the COCs through destructive mechanisms.

Alternative 2 relies on natural processes to degrade contaminants and, as such, the reduction in TMV of contaminants will vary with location. Under Alternative 2, the MNA biodegradation processes can transform PCE, TCE, and cis-1,2-DCE into the more toxic vinyl chloride under anaerobic conditions before transformation to the less toxic ethane. This transformation would need to be monitored and managed to prevent potential exposure to contaminated drinking water. Physical processes such as dispersion are working to reduce the toxicity by decreasing contaminant concentrations. The presence of cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride, which are ethene breakdown products of PCE and TCE, is evident. However, the limited MNA data set has revealed this breakdown is not occurring throughout the entire OU1 area. Total VOC groundwater concentrations greater than a 1,000 µg/L coupled with the absence of a significant rate of complete biodegradation indicate that Alternative 2 would not reduce the TMV of contaminants significantly.

Alternatives 3, 4, and 5 would reduce the toxicity and volume of contaminants through active remedial treatment of contaminated groundwater. Alternative 3 uses a system to remove the contaminants from groundwater in-situ and provides chemical treatment for the collected vapor-phase contamination on-Site. Alternative 4 removes contaminated groundwater via extraction and treats the contamination via a carbon-treatment process on-Site. Alternative 5 utilizes both those technologies and treats vapor phase-contamination and extracted groundwater on-Site at a central treatment plant.

Under Alternatives 3, 4, and 5, in-situ chemical treatment such as ISCO would be applied to areas where total VOC concentrations exceed a 10,000 µg/L so as to reduce the TMV of those contaminants. After treatment, Alternatives 3, 4, and 5 would generate residuals in the form of spent used GAC that would require regeneration, destruction or disposal.

Alternative 5 would be the most effective at reducing the TMV of contaminants because each of the technologies would be applied to those areas best suited for its application, based on depth and concentrations of contaminants. For example, in-well vapor stripping would be utilized in more shallow areas and where concentrations of total VOCs are comparatively low to moderate (*e.g.*, less than a 1,000 µg/L). Extraction and treatment would be utilized where total VOC concentrations are comparatively higher (*e.g.*, greater than 1,000 µg/L) and at intermediate and deeper depths where in-well vapor stripping may not be as effective. If pilot testing indicates that in-well vapor stripping would not be an efficient technology at reducing the TMV of contaminants for portions of targeted treatment zones then extraction and treatment could be implemented in those areas under Alternative 5.

10.5 Short-Term Effectiveness

Alternative 1 would be the most effective in the short term as there would be no risks posed during the implementation of this alternative. Thereafter, Alternative 2 would be the second most effective in the short term as it would only require the installation of monitoring wells and sample collection.

Alternatives 3, 4, and 5 may have short-term impacts to remediation workers, the public, and the environment during implementation. Remedy-related construction (*e.g.*, trench excavation) under Alternatives 3, 4, and 5 would require disruptions in traffic, and street closures. In addition, Alternatives 3, 4, and 5 have above-ground treatment components and infrastructure that may create a minor noise nuisance and inconvenience for local residents during the construction.

Exposure of workers, the surrounding community, and the local environment to contaminants during the implementation of Alternatives 3, 4, and 5 would be minimal. Drilling activities, including the installation of monitoring, in-well vapor stripping, and extraction wells for Alternatives 3, 4, and 5 could produce contaminated liquids that present some risk to remediation workers at the Site. The potential for remediation workers to have direct contact with contaminants in groundwater could also occur when groundwater remediation systems are operating under Alternatives 4 and 5. Alternatives 4 and 5 could increase the risks of exposure, ingestion, and inhalation of contaminants for workers because contaminated groundwater would be extracted to the surface for treatment. However, measures could be implemented to mitigate exposure risks.

Alternatives 3, 4, and 5 include monitoring that would provide the data needed for proper management of the remedial processes and a mechanism to address any potential impacts to the community, remediation workers, and the environment. Risk from exposure to groundwater during any excavation work would require management via occupational health and safety controls, such as dust control measures.

Groundwater monitoring and discharge of treated groundwater would have minimal impact on workers responsible for periodic sampling. The time required for implementation of Alternatives 3, 4, and 5 is estimated to take one to two years.

10.6 Implementability

Alternative 1 is no action and therefore is the easiest of all the alternatives to implement. Alternative 2, MNA, is a well-established remedial approach that is also easily implementable because no active remediation would be performed. Alternative 2 would include the installation of an expanded monitoring well network and sample collection and analysis.

In-well vapor stripping and groundwater extraction and treatment are well-established technologies that utilize commercially available equipment and are implementable. However, obtaining the necessary access to implement Alternatives 3, 4, and 5 may pose access challenges because they require multiple wells, below ground piping, and treatment buildings needed to be constructed on multiple owners' properties.

Of the three active remediation alternatives, Alternative 4 would be the easiest alternative to construct and would require the least amount of street closures, less land area, and less disruption in residential areas. Alternative 3 would be the most difficult to implement because construction activities would result in a significant disruption in residential areas. This alternative would require installation of a large number of wells and associated infrastructures. The ability to reconfigure in-well vapor-stripping well locations because of access constraints may be possible; however, doing so could potentially impact the effectiveness and schedule of Alternatives 3 and 5. Additionally, design challenges would increase with Alternatives 3 and 5 as the vapors captured from the in-well vapor-stripping wells would need to be transported via transmission lines and blowers to a centralized treatment plant.

Under Alternative 3, the depth of the deepest contamination (estimated between approximately 285 to 502 feet bgs) increases the design challenges of the in-well vapor system. There are practical limitations on the depth that compressed air can be injected into the aquifer which could impact the effectiveness in vapor-stripping over a portion of the treatment well. Additionally, anisotropic aquifer conditions potentially present in portions of the aquifer could potentially reduce the success of an in-well vapor-stripping well to establish a groundwater circulation cell across the treatment zone of the aquifer.

Use of in-situ chemical treatment such as ISCO, under Alternatives 3, 4, and 5, is a well-established treatment that is commercially available. A treatability study would be performed during the remedial design to evaluate the use of in-situ chemical treatments, such as ISCO, as an element of the selected alternative to complement and improve the effectiveness of the remedy. In-situ chemical treatment would only be utilized if a determination is made during the remedial design that its application would not adversely affect the public supply wells. Alternatives 2, 3, 4, and 5 would require routine groundwater quality, performance, and administrative monitoring, including five-year CERCLA reviews. Alternative 3, 4, and 5 would require periodic operation and maintenance (*e.g.*, substrate inspection, GAC replacement) for the life of the treatment. Reinjection of all or part of treated water under alternatives 4 and 5 could present implementability challenges if a suitable location is not agreed upon between the EPA and local and county officials. A final determination would be made on discharge location or method once additional design information has been generated.

10.7 Cost

The estimated capital costs, O&M, and present worth cost are discussed in detail in the EPA's July 2013 OU1 Supplemental FS Memorandum. For estimating costs and for planning purposes, a 30 year time frame was used for O&M under Alternatives 2, 3, 4, and 5. Alternative 1 had no associated costs as no action would be taken. The costs estimates are based on the best available information and are provided in the table below. The highest present worth cost is Alternative 4 at $24.2 million. Of the three alternatives with active remedial components, Alternative 5 is slightly less expensive than Alternatives 3 and 4.

Alternative	Capital Cost	Annual O&M Cost	Present Worth
1	$0	$0	$0
2	$ 614,000	$115,000	$3,300,000
3	$11,727,000	$652,000	$24,000,000
4	$ 8,862,000	$834,000	$24,200,000
5	$10,044,000	$680,000	$22,900,000

10.8 State/Support Agency Acceptance

NYSDEC concurs with the selected remedy. A letter of concurrence is attached in Appendix IV.

10.9 Community Acceptance

The EPA solicited input from the community on the remedial alternatives proposed for OU1 at the Site. Verbal comments received from community members at the August 15, 2013 public meeting generally related to vapor intrusion and the Superfund process. During the comment period from July 26, 2013 through September 24, 2013, approximately seven comment letters were received via email and U.S. mail. Copies of the comment letters are provided as Attachment 6 to Appendix V. The majority of comments received were submitted from potentially responsible parties at the Site. The New Cassel Business Association also submitted comments which among other things questioned the effect construction activities would have on the residential and business communities. Additionally, the Hicksville Water District submitted questions and comments regarding components of the preferred remedy and future OUs at the Site. A summary of significant comments contained in the letters and the comments provided at the public meeting on August 15, 2013, as well as EPA's responses to those comments, are provided in the Responsiveness Summary (Appendix V).

11. PRINCIPAL THREAT WASTES

The NCP establishes an expectation that the EPA will use treatment to address the principal threats posed by a Site whenever practicable (NCP Section 300.430(a)(1)(iii)(A)). The "principal threat" concept is applied to the characterization of "source materials" at a Superfund site. A source material is material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for the migration of contamination to groundwater, surface water, or air, or act as a source for direct exposure. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment in the event exposure should occur. The decision to treat these wastes is made on a site-specific basis through a detailed analysis of alternatives, using the remedy selection criteria which are described above. The manner in which principal threat wastes are addressed provides a basis for making a statutory finding that the remedy employs treatment as a principal element.

The contamination addressed in this ROD is in the groundwater. Contaminated groundwater is generally not considered to be source material; however, the potential for DNAPL in groundwater may be viewed as source material. Analytical results from previous investigations indicate that the eastern portion of the plume contains concentrations of PCE as high as 75,000 μg/L indicative of the presence of DNAPL. The selected remedy will actively address this portion of the plume.

12. SELECTED REMEDY

12.1 Summary of the Rationale for the Selected Remedy

Based upon the requirements of CERCLA, the results of OU1 investigations, the detailed analysis of the alternatives, and public comments, the EPA has determined that Alternative 5 best satisfies the requirements of CERCLA Section 121, 42 U.S.C. §9621, and provides the best balance of tradeoffs among the remedial alternatives with respect to the NCP's nine evaluation criteria, 40 CFR §300.430(e)(9).

While Alternative 3, in-well vapor stripping, and Alternative 4, extraction and treatment, are both proven technologies to remediate VOC contaminated groundwater actively, there are difficulties and uncertainties at this OU associated with relying solely on one of these remedial technologies to address OU1 groundwater contamination.

Relying exclusively on in-well vapor stripping as envisioned under Alternative 3 would be difficult in a densely populated and developed residential setting. Alternative 3 would require the installation of large numbers of wells and associated infrastructure and would result in a significant disruption in a largely residential area and an increased remedial costs. In addition, the depth of the deepest contamination (estimated between approximately 285 to 502 feet bgs) increases the design challenges of the in-well vapor-stripping system. Limits on the hydraulic depth to which the compressed air can be injected into the aquifer could result in air stripping being conducted over only a portion of the treatment well. Anisotropic aquifer conditions potentially present in portions of the aquifer could reduce the potential for an in-well stripping well to establish a groundwater circulation cell across the treatment zone of the aquifer.

Utilizing extraction and treatment as the primary remedial technology in Alternative 4 increases the volume of extracted groundwater that would require ex-situ treatment and handling, thereby increasing both the capital costs and annual operations and maintenance costs without providing a significant reduction of the TMV of contaminants relative to Alternative 5, the selected remedy.

The EPA's selected remedy incorporates a combination of in-well vapor stripping and extraction and treatment. The remedy will be designed to utilize the different technologies effectively to target groundwater contamination within OU1, based upon location-specific conditions (*i.e.*, depth to treatment and concentration levels). Utilizing both in-well vapor stripping and extraction and treatment will provide additional cost-saving measures, as outlined above in Section 10.7, by reducing either the capital or O&M costs that would have been associated with installing and operating independent remedial systems. Each of the treatment components will be optimized during the remedial design to improve treatment effectiveness or decrease the overall remedial time frame.

The approach of the selected remedy is expected to be effective because the contaminant plumes in the OU1 eastern plume and portions of the OU1 western plume are more extensive laterally and/or vertically (greater than 250 feet bgs). For the OU1 eastern and portions of the OU1 western plume, use of extraction and treatment is a proven technology that is effective at reducing contaminant mass and providing containment of the contaminant plume under these conditions. In-well vapor stripping is expected to be more effective in the OU1 central plume, where the contaminant plume is generally less extensive laterally and vertically and generally has lower concentrations of total VOCs, as well as in portions of the OU1 western plume. If, during the remedial design investigation activities, it is determined that in-well vapor stripping will not be an effective technology for addressing contamination at the OU1 central and portions of the OU1 western plume, then the existing extraction and treatment component of the selected remedy will be utilized as the active remedial technology in those areas as well.

Access to install the in-well vapor-stripping wells and the extraction wells as set forth in the selected remedy, Alternative 5, is more manageable although admittedly complicated. The treatment plant will be sited in an area that is not zoned residential. The conceptual design for the selected remedy is provided as Figure 3 in Appendix I.

In-situ chemical treatment, such as ISCO, will be used to target areas containing very high concentrations of total VOCs. It will, as appropriate, be utilized in combination with groundwater extraction or in-well vapor stripping in an effort to reduce the remediation time frames by more effectively reducing the contaminant mass of total VOCs and, therefore, the resulting costs of the selected remedy.

12.2 Description of the Selected Remedy

The response action selected in this ROD represents the first remedial phase for the Site. It actively addresses groundwater contamination in the area downgradient of Old Country Road, Grand Boulevard, and the NCIA and is considered an interim remedy for OU1 at the Site. The EPA anticipates conducting a separate investigation of one or more additional OUs to address groundwater contamination at the Site, including in the far-afield area further downgradient of the portion of the plume addressed in this OU1. Additional planned OUs for the Site include, but may not be limited to, areas of groundwater contamination impacting the Hicksville public supply wells 5-2, 5-3, 4-2, 8-1, 8-3, 9-3 and Hempstead-Levittown 2A.
The major components of the selected remedy include the following:

- A combination of (a) in-situ treatment of groundwater via in-well vapor stripping and (b) extraction of groundwater via pumping and ex-situ treatment of extracted groundwater prior to discharge to a POTW or reinjection to groundwater (to be determined during design). The purpose is to establish containment and effectuate removal of contaminant mass where concentrations of total VOC concentrations are greater than 100 μg/L;

- In-situ chemical treatment, such as ISCO, to target high concentration contaminant areas, as appropriate;

- Implementation of long-term monitoring to track and monitor changes in groundwater contamination in OU1 to ensure the RAOs are attained;

- Development of a Site Management Plan to ensure proper management of the Site remedy post-construction. The Site Management Plan will include provisions for any O&M and long-term monitoring required for the remedy, as well as periodic certifications; and

- Institutional controls consisting of any existing local requirements that prevent installation of drinking water wells, and informational devices to limit exposure to contaminated groundwater.

Individual facilities within the NCIA are considered to be among the sources of groundwater contamination for OU1. Response actions which are addressing sources of contamination in the NCIA are being conducted at those upgradient facilities, and they continue to be overseen by NYSDEC under its state hazardous waste cleanup program. The on-going, State-authorized response actions at the NCIA facilities are not part of this OU1, although the successful completion (*i.e.,* source control or cleanup) of addressing the source area(s) at the upgradient individual NCIA facilities, under NYSDEC oversight are anticipated and was assumed in evaluating the potential for attaining the objectives of the selected remedial alternative in this ROD. In the event that theses sources are not successfully addressed, the EPA may elect to evaluate additional options at individual NCIA facilities pursuant to CERCLA in a future operable unit to ensure the effectiveness of the selected remedy.

The environmental benefits of this remedy may be enhanced by giving consideration, during the design phase, to technologies and practices that are sustainable in accordance with the EPA Region 2's Clean and Green Energy Policy[9]. This will include consideration of green remediation technologies and practices, including granular activated carbon regeneration.

12.3 Summary of the Estimated Remedy Costs

The estimated capital, annual O&M, and total present-worth costs for the selected remedy are $10,044,000, $680,000, and $22,900,000, respectively. The costs estimates are based on available information and are order-of-magnitude engineering cost estimates that are expected between +50 to -30 percent of the actual project cost. Changes to the cost estimate can occur as a result of new information and data collected during the design of the remedy. Individual cost estimates for each remedial alternative are provided in the EPA's OU1 Supplemental FS Memorandum dated July 2013.

12.4 Expected Outcomes of the Selected Remedy

The selected remedy addresses areas of VOC contamination at OU1 at the Site. The results of the HHRA indicate that the hypothetical future use of groundwater at OU1 of the Site will pose an unacceptable increased future cancer risk and unacceptable noncancer hazards to human health if no action is taken. Under the selected remedy, a combination of in-well vapor stripping, groundwater extraction and treatment technologies, and in-situ chemical treatment, as applicable, will be used to remediate contaminated groundwater and will restore the aquifer at OU1 as a potential source of drinking water in a reasonable timeframe by reducing contaminant levels to

[9] See http://epa.gov/region2/superfund/green_remediation.

the federal MCLs and state standards. This interim action remedy selected for OU1 is an initial action intended to minimize further migration of contaminants while an RI of the far-afield area can be conducted. The selected remedy does not constitute the final remedy for the Site. Additional data concerning Site-related contamination, to be generated during the far-afield RI, may become available prior to implementation of the selected remedy. This data may be considered during the design of the selected remedy.

Cleanup levels for the COCs are presented in Appendix II, Table 7. Achieving the cleanup levels will restore the aquifer to its beneficial use.

13. STATUTORY DETERMINATIONS

The EPA and the State of New York believe that the selected remedy complies with the CERCLA and NCP provisions for remedy selection, meets the threshold criteria, and provides the best balance of tradeoffs among the alternatives with respect to the balancing and modifying criteria. These provisions require the selection of remedies that are protective of human health and the environment, comply with ARARs (or justify a waiver from such requirements), are cost effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the TMV of hazardous substances as a principal element (or justifies not satisfying the preference). The following sections discuss how the selected remedy meets these statutory requirements.

13.1 Protection of Human Health and the Environment

The selected remedy will protect human health and the environment because it will over the long-term restore groundwater quality at OU1 at the Site to drinking-water standards. Protection will also be achieved by eliminating all remaining direct-contact risks to human health associated with contaminated groundwater. Institutional controls will also assist in protecting human health over both the short- and long-term by helping to control and limit exposure to hazardous substances.

13.2 Compliance with ARARs

The selected remedy is expected to achieve federal MCLs or more stringent state standards for the COCs in the groundwater. The COCs and the relevant MCLs are as provided in Table 7, which can be found in Appendix II.

A full list of the ARARs, TBCs, and other guidance related to implementation of the selected remedy is presented in Tables 8, 9, and 10, which can be found in Appendix II.

13.3 Cost Effectiveness

A cost-effective remedy is one in which costs are proportional to its overall effectiveness (NCP Section 300.430(f)(1)(ii)(D)). Overall, effectiveness is based on the evaluations of long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness. The EPA evaluated the "overall effectiveness" of those alternatives that satisfied the threshold criteria (*i.e.,* those that were both protective of human health and the environment and ARAR-compliant). Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume though treatment; and short-term effectiveness). Overall effectiveness was then compared to costs to determine cost-effectiveness.

Each of the alternatives has undergone a detailed cost analysis. In that analysis, capital and annual O&M costs were estimated and used to develop present-worth costs. In the present-worth cost analysis, annual O&M costs were calculated for the estimated life of each alternative. The total estimated present-worth cost for implementing the selected remedy is $22,900,000.

Based on the comparison of overall effectiveness to cost, the selected remedy meets the statutory requirement that Superfund remedies be cost-effective (NCP Section 300.430(f) (1) (ii)(D)) and is the least-cost action which will achieve groundwater standards within a reasonable time frame. A 30 year timeframe was used for planning and estimating purposes to remediate groundwater, although remediation timeframes could exceed this estimate.

13.4 Utilization of Permanent Solutions and Alternative Treatment (or Resource Recovery) Technologies to Maximum Extent Practicable

The selected remedy provides the best balance of tradeoffs among the alternatives with respect to the balancing criteria set forth in NCP Section 300.430(f)(1)(i)(B), because it represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at OU1. The selected remedy satisfies the criteria for long-term effectiveness and permanence by removing contaminant mass from areas of OU1 with elevated levels of VOC concentrations. The combination of in-well vapor stripping and extraction and treatment with use of in-situ chemical treatment, as applicable, will permanently reduce the mass of contaminants in OU1 groundwater, thereby reducing the toxicity, mobility, and volume of contamination.

The selected remedy is implementable because it employs standard technologies that are readily available and allows flexibility through the combination of active remedial components. Additionally, the selected remedy allows flexibility to use in-situ chemical treatments to enhance the remediation of contaminated groundwater in conjunction with the active remedial components.

13.5 Preference for Treatment as a Principal Element

Through the use of a combination of an in-situ (in-well vapor-stripping and in-situ chemical treatment) and ex-situ (extraction and treatment) technologies, the selected remedy satisfies the statutory preference for remedies that employ treatment as a principal element.

13.6 Five-Year Review Requirements

This remedy will result in hazardous substances, pollutants, or contaminants remaining at this OU until performance standards are attained, and as such, use and exposure must be limited until such standards are met. Since it may take more than five years to attain the cleanup levels, policy reviews pursuant to Section 121(c) of CERCLA will be conducted no less often than once every five years after the completion of construction to ensure that remedy is, or will be, protective of human health and environment.

14. DOCUMENTATION OF SIGNIFICANT CHANGES

The Proposed Plan for OU1 of the Site was released on July 26, 2013. The Proposed Plan identified Alternative 5 as the preferred alternative for remediating the contaminated groundwater. The EPA received a request to extend the public comment period and extended the comment period until September 24, 2013.

The EPA reviewed all written (including electronic formats such as e-mail) and oral comments during the public comment period. The EPA has determined that no significant changes to the remedy, as originally identified in the Proposed Plan, are necessary or appropriate.

APPENDIX I
FIGURES

APPENDIX II
TABLES

Table 7

Cleanup Levels for Contaminants of Concern in OU1 Groundwater

Chemicals of Concern (COCs)	NYSDEC Water Quality Standard (μg/L)	Federal Maximum Contaminant Level (μg/L)	NYSDOH Drinking Water Quality Standards (μg/L)	Remediation Goal [A] (μg/L)
1,1,2,2- Tetrachloroethane	5	No Standard (NS)	5	5
1,1,2- Trichloroethane	1	5	5	1
1,1- Dichloroethane	5	NS	5	5
1,1-Dichloroethene	5	7	5	5
Chloroform	7	80	50	7
Cis-1,2-Dichloroethene	5	70	5	5
Tetrachloroethene	5	5	5	5
Trichloroethene	5	5	5	5
Vinyl chloride	2	2	2	2

Notes:

[A] The remediation goal represents the level to which each COC will be cleaned up to. The cleanup level is the more stringent of the federal or state value listed above. The table does not include all ARARs, TBCs and other guidance that applies to the remedy selected in this ROD.

Table 8

Chemical-Specific ARARs, TBCs, and Other Guidance

REGULATION/ AUTHORITY	CITATION	REQUIREMENT SYNOPSIS
National Primary Drinking Water Standards	42 U.S.C. § 300f et seq and 40 CFR Part 141, Subpart F	These federal standards establish maximum contaminant levels (MCLs) which are health-based standards for public water systems.
New York State Groundwater Quality Standards	ECL §§3-0301[2][m], 15-0313, 17-0301, 17-0809; 6 NYCRR Part 703	Provides numerical groundwater quality standards.
New York State Department of Health Drinking Water Standards	10 NYCRR Part 5	Sets standards for public drinking water supplies.

Table 9
Location-Specific ARARs, TBCs, and Other Guidance

REGULATION/ AUTHORITY	CITATION	REQUIREMENT SYNOPSIS
National Historic Preservation Act	16 U.S.C. §§470-470x-6; 36 C.F.R. Part 800	Establishes that response actions must take into account effect on properties currently listed or eligible for inclusion on the National Registry of Historic Places. Requires federal agencies to take into account the effects of their undertakings on historic properties and afford the council a reasonable opportunity to comment on such undertakings. This will include consultation with state and local governments, and private organizations as necessary.

Table 10
Action-Specific ARARs, TBCs, and Other Guidance

REGULATION/ AUTHORITY	CITATION	REQUIREMENT SYNOPSIS
General Requirement for Site Remediation		
Occupational Safety and Health Act (OSHA) - General Industry Standards	29 USC §553 and 42 USC§126; 29 CFR §1910.120	These regulations specify the 8-hour time-weighted average concentration for worker exposure to various compounds. Training requirements for workers at hazardous waste operations are specified in 29 CFR §1910.120.
OSHA – Safety and Health Standards	40 U.S.C. §333; 29 U.S.C. §§653, 655, 657; 29 CFR Part 1926	These regulations specify the type of safety equipment and procedures to be followed during site remediation.
OSHA – Recordkeeping, Reporting and Related Regulations	29 U.S.C. §§657, 658, 660, 669, 673; 29 CFR Part 1904	These regulations outline recordkeeping and reporting requirements for an employer under OSHA.
Resource Conservation and Recovery Act (RCRA) – General Standards	42 U.S.C. §§6905, 6912(a), 6924, and 6925; 40 CFR Part 264	General performance standards requiring minimization of need for further maintenance and control. Also requires decontamination or disposal of contaminated equipment, structures and soils. Outlines requirements for safety equipment and spill control when treating, handling and/or storing hazardous wastes. Provides emergency procedures to be used when following explosions, fires, etc. when storing hazardous wastes.
RCRA 90-Day Accumulation Rule for Hazardous Waste	42 U.S.C.§§ 6906, 6912, 6922-6925, 6937, and 6938; 40 CFR Part 262	Allows generators of hazardous waste to store and treat hazardous waste at the generation site for up to 90 days in tanks, containers and containment buildings without having to obtain a RCRA hazardous waste permit.
RCRA Hazardous Waste Permit Program	42 U.S.C. §6925; 40 CFR Part 270	Covers the basic permitting, application, monitoring and reporting requirements for off-site hazardous waste management facilities.
REGULATION/ AUTHORITY	**CITATION**	**REQUIREMENT SYNOPSIS**

General Requirement for Site Remediation (continued)		
Superfund Green Remediation Strategy	www.epa.gov/superfund/greenremediation/sf-gr-strategy.pdf	Provides the EPA's strategy to clean up hazardous waste sites in ways that use natural resources and energy efficiently and reduces negative impacts on human health and the environment.
Green Remediation	DER-31	Provides concepts and techniques of green remediation and guidance on how to apply them to remedial programs under DER.
New York Hazardous Waste Management System - General	ECL, Article 27; 6 NYCRR Part 370	Outlines criteria for determining if a solid waste is a hazardous waste and is subject to regulation under 6 NYCRR Parts 371-376.
Identification and Listing of Hazardous Wastes	ECL, Article 27; 6 NYCRR Part 371	Outlines criteria for determining if a solid waste is a hazardous waste and is subject to regulation under 6 NYCRR Parts 371-376.
New York Regulations for Hazardous Waste Management Facilities	ECL, Article 27; 6 NYCRR Part 373.1.1 - 373.1.8	Provides requirements and procedures for obtaining a permit to operate a hazardous waste treatment, storage and disposal facility. Also lists contents and conditions of permits.
Waste Transportation		
U.S. Department of Transportation (USDOT) Rules for Transportation of Hazardous Materials	49 CFR Parts 107 and 171.1-172.558	Outlines procedures for the packaging, labeling, manifesting and transporting of hazardous materials.
RCRA- Standards Applicable to Transporters of Applicable Hazardous Waste	42 U.S.C.§§ 6906, 6912, 6922-6925, 6937, and 6938; 40 CFR Part 263	Establishes the responsibility of off-site transporters of hazardous waste in the handling, transportation and management of the waste. Requires manifesting, recordkeeping and immediate action in the event of a discharge.
REGULATION/ AUTHORITY	**CITATION**	**REQUIREMENT SYNOPSIS**
Waste Transportation (continued)		

New York State Hazardous Waste Manifest System and Related Standards for Generators, Transporters, and Facilities	ECL, Article 27; 6 NYCRR Part 372	Provides guidelines relating to the use of the manifest system and its recordkeeping requirements. It applies to generators, transporters and facilities in New York State.
Waste Transporter Permits	ECL, Article 27, Titles 3, 9, and 15; 6 NYCRR Part 364	Governs the collection, transport and delivery of regulated waste within New York State.
Disposal		
New York Standards for Universal Waste and Land Disposal Restrictions	ECL, Article 27; 6 NYCRR Part 374-3 6 NYCRR Part 376	These regulations establish standards for treatment and disposal of hazardous wastes.
Groundwater Discharge		
Clean Water Act	CWA [40 CFR 122, 125)	National Pollutant Discharge Elimination System (NPDES) permit requirements for point source discharges must be met, including the NPDES Best Management Practice (BMP) Program. These regulations include, but are not limited to, requirements for compliance with water quality standards, a discharge monitoring system, and records maintenance.
Safe Drinking Water Act – Underground Injection Control Program	40 CFR 144, 146	Establish performance standards, well requirements, and permitting requirements for groundwater re-injection wells.
New York Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations	6NYCRR Part 703	Establish numerical criteria for groundwater treatment before discharge.
New York State Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations	TOGS 1.1.1	Provides groundwater effluent limitations for use where there are no standards.
REGULATION/ AUTHORITY	**CITATION**	**REQUIREMENT SYNOPSIS**
Off-Gas Management		

Clean Air Act-National Ambient Air Quality Standards	42 U.S.C. §§7401-7671q; 40 CFR Parts 50-52 60 and 40	Establishes ambient air quality standards for protection of public health.
Federal Directive – Control of Air Emissions from Superfund Air Strippers	OSWER Directive 9355.0-28	These provide guidance on the use of controls for Superfund site air strippers as well as other vapor extraction techniques in attainment and non-attainment areas for ozone.
New York Air Quality Standards/	DER-10 6 NYCRR Part 257	This regulation requires that maximum 24-hour concentrations for particulate matter not be exceeded more than once per year. Fugitive dust emissions from site excavation activities must be maintained below 250 micrograms per cubic meter ($\mu g/m^3$).
NYSDEC Guidelines for the Control of Toxic Ambient Contaminants	DAR-1 Air Guide 1	This policy provides guidance for the control of toxic ambient air contaminants and outlines the procedures for evaluating sources.
New York Permits and Certificates	6 NYCRR Part 201	Permits may be exempted for listed trivial activities.
New York Emissions Verification	6 NYCRR Part 202	Specifies the sampling and documentation requirements for off-gas emissions.
New York General Prohibitions	6 NYCRR Part 211	Prohibition applies to any particulate, fume, gas, mist, odor, smoke, vapor, pollen, toxic or deleterious emissions.
New York General Process Emission Sources	6 NYCRR Part 212	Sets the treatment requirements for certain emission rates.